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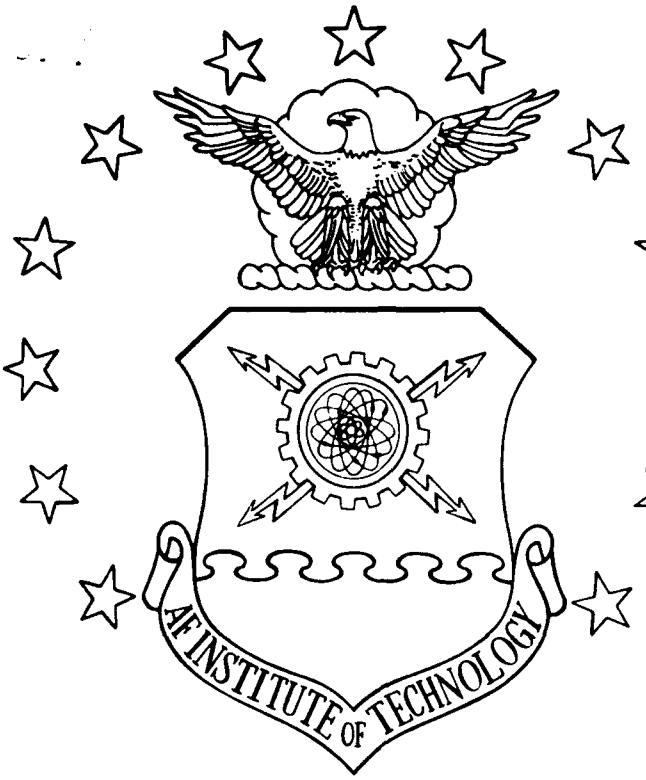

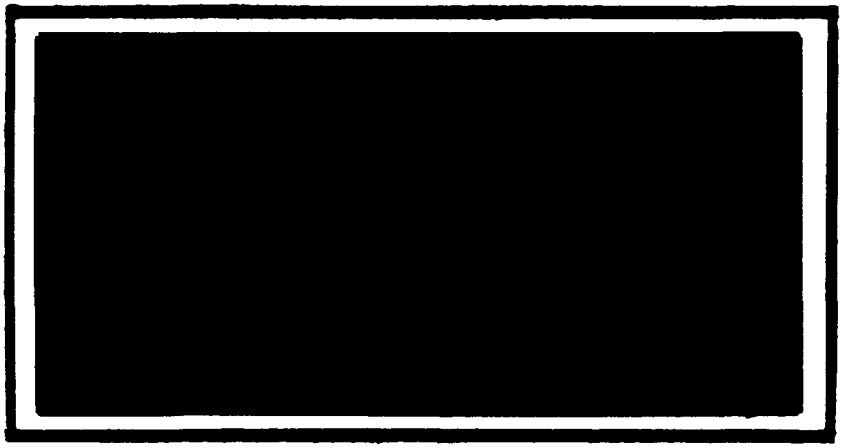

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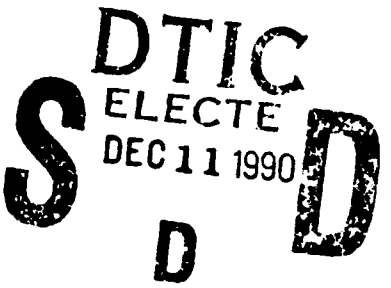

AN ASSESSMENT OF THE EFFECTIVENESS OF ENGINEERING MANAGEMENT OF THE ROYAL AUSTRALIAN AIR FORCE F/RF-111C WEAPON SYSTEM

THESIS

Robert R. Black, BE
Squadron Leader, RAAF

AFIT/GLM/LSM/90S-4

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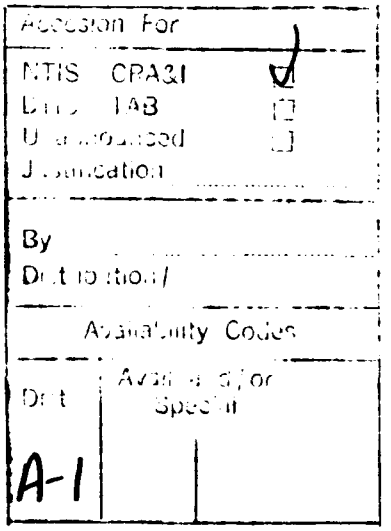

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AN ASSESSMENT OF THE EFFECTIVENESS OF ENGINEERING MANAGEMENT OF THE ROYAL AUSTRALIAN AIR FORCE F/RF-111C WEAPON SYSTEM

THESIS

Presented to the Faculty of the

School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Logistics Management

Robert R. Black, BE

Squadron Leader, RAAF

September 1990

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In an endeavour of this nature, the research is not the effort of one but the efforts of many. From the efforts of many, I am the fortunate person whose name appears as the author of this research.

My thanks go to those people in the RAAF who provided me with not only their important contribution to this research, but who have also guided me through my professional career: Group Captain Bob Bennett, Wing Commander Chris Hau, Wing Commander Peter McDonald, Squadron Leader Mark Schirmer, Flight Sergeant Ken Anson, Flight Sergeant David Box, Flight Sergeant Gary Childs, Flight Sergeant Patrick Rothe and Sergeant Les Worthington.

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Finally, my love and thanks go to my wife Susan for her patience and understanding, and my darling children Jenna and Robert for their special contributions - especially the crayon graphics.

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Abstract

The purpose of this research was to assess the effectiveness of engineering management of the Royal Australian Air Force (RAAF) F/RF-111C Weapon System by Headquarters Support Command (HQSC) Logistics Engineering (LOGENG) Sub-Branch. The research was limited to considering the organization, functions and responsibilities of HQSC LOGENG Sub-Branch, modification management, configuration management and technical publication management.

The division of engineering responsibilities within the RAAF and existing engineering management policy and procedures as detailed in various technical instructions and publications were documented. The strengths and weaknesses of various organization structures were then described. Measures of organization effectiveness, modification management and configuration management were addressed. Formal interviews were conducted to determine the existing level of effectiveness of engineering management.

The research concluded that the effectiveness of engineering management of the F/RF-111C Weapon System can be improved. The research recommends that HQSC LOGENG Sub-Branch be reorganized into a hybrid organization structure, a standard review and approval process for modifications be

implemented, a configuration management plan be issued for the F/RF-111C Weapon System and the publication amendment cycle be improved to increase the integrity of technical data.

AN ASSESSMENT OF THE EFFECTIVENESS OF ENGINEERING MANAGEMENT OF THE ROYAL AUSTRALIAN AIR FORCE F/RF-111C WEAPON SYSTEM

"Who can put a price on a satisfied customer, and who can figure the cost of a dissatisfied customer?"

W. Edwards Deming (4:9)

I. Introduction

Overview

This research assessed the effectiveness of engineering management of the Royal Australian Air Force (RAAF) F/RF-111C Weapon System by Headquarters Support Command (HQSC) Logistics Engineering (LOGENG) Sub-Branch.

This chapter outlined the objective of the RAAF. The organization of the RAAF was then described as it applies to the F/RF-111C Weapon System. This objective and description of the RAAF organization formed the foundation for a statement of the purpose of this research and the investigative questions which were used to form the research's framework. This chapter concluded with a discussion of the scope and limitations of the research.

Objective of the Royal Australian Air Force

The objective of the RAAF is to provide air forces structured for:

> a. credible air contingencies in defence of Australia, its territories and approaches, generally as part of a joint force, and including support of maritime and land operations; and
>
> b. longer term expansion should this be required.
>
> The RAAF is to provide [*inter alia*]: (1) combat aircraft for reconnaissance and strike against maritime and land targets; and (2) a logistics organization for supporting the operation and deployment of forces. (8:17)

Organization of the Royal Australian Air Force

The organization of the RAAF reflects the need for air forces capable of conducting air operations and supporting maritime and land operations. The RAAF is organized into three major components: the Departmental component, the operational component and the support component. The Departmental component is Air Force Office (AFO) and comprises the Chief of the Air Staff and his functional staffs; the operational component is Air Command under Air Commander Australia and contains the standing combat elements of the RAAF: (1) Strike and Reconnaissance Group (SRG); (2) Tactical Fighter Group; (3) Maritime Patrol Group; (4) Air Lift Group; and (5) Tactical Transport Group. The support component is HQSC commanded by the Air

Officer Commanding Support Command, and includes the Logistics Branch.

An outline of the organization of the RAAF as it applies to the F/RF-111C Weapon System is provided in Figure 1 (adapted from 8:17-19; 27:1; 30:1).

Strike and Reconnaissance Group. SRG is responsible for providing combat aircraft for reconnaissance and strike missions against maritime and land targets. The RAAF uses 18 F-111C and four RF-111C aircraft as the strike and reconnaissance platforms respectively. These aircraft represent an unique capability in regional terms. The F-111C aircraft entered operational service in 1973 and the RF-111C aircraft entered operational service in 1978. The force capability of the F-111C strike aircraft was significantly upgraded with the installation of the PAVE TACK/Guided Weapons System (PT/GWS) vide F-111C Modification 7214.003-400. This modification programme was completed in 1988.

HQSC Logistics Engineering Sub-Branch. Logistics Branch was created in 1983 as a result of a reorganization of HQSC, and is responsible for logistic support for the operation and deployment of forces. HQSC Logistics Branch comprises several sub-branches, divisions and sections. Within HQSC Logistics Branch, HQSC LOGENG Sub-Branch is responsible for engineering management of the F/RF-111C Weapon System and other combat weapon systems.

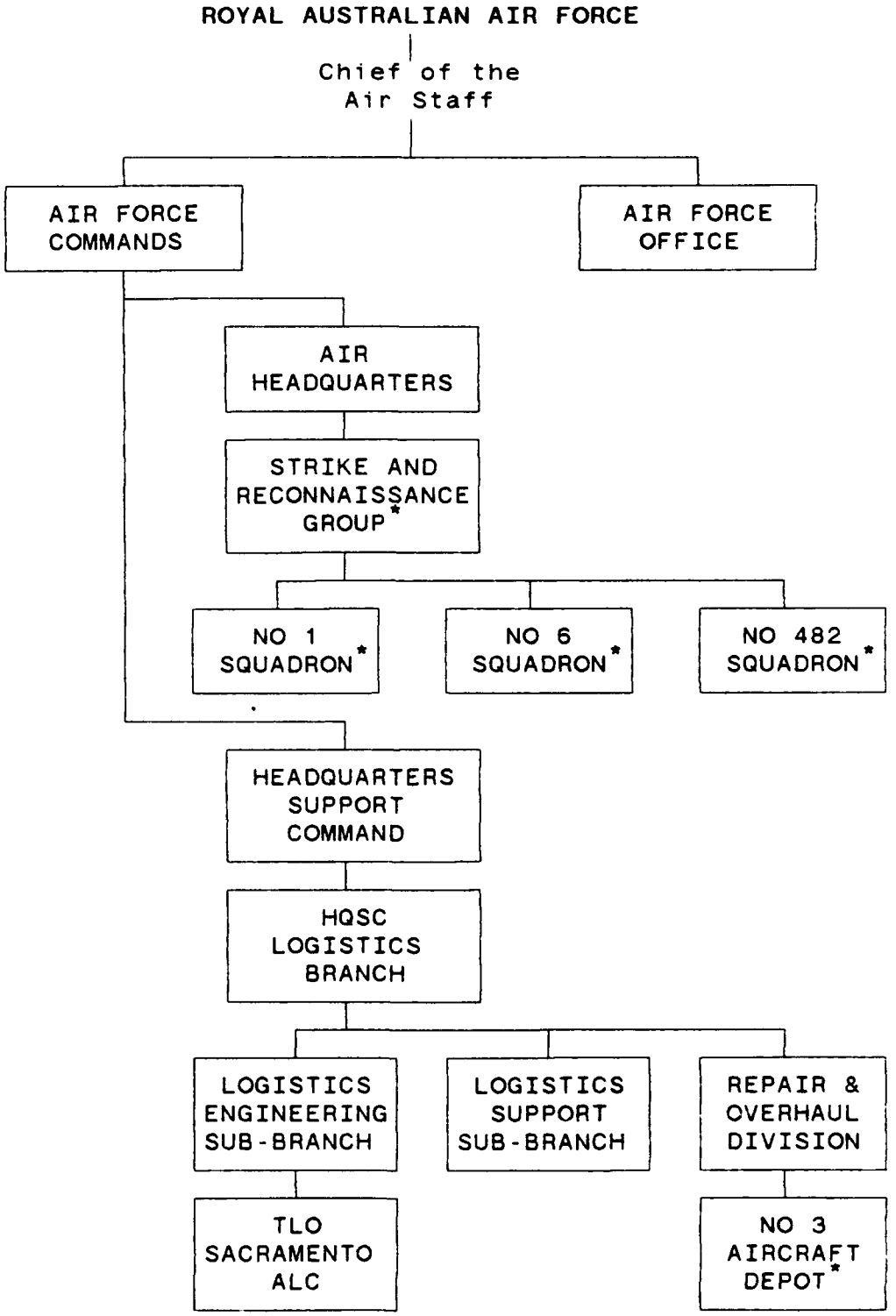

Figure 1. RAAF Organization - F/RF-111C Weapon System

* Based at RAAF Base Amberley

Definition of Terms

A complete Glossary of Terms, Abbreviations and Acronyms are provided in Appendix A. Definitions of significant constructs used in this research are provided below:

a. Effectiveness.

> [Effectiveness is] a measure of the extent to which an item satisfies a set of specific, pre-established requirements. (6:256)

b. Engineering Management.

> [Engineering management is the] planning, organizing, directing, coordinating and controlling of all engineering functions and processes associated with the airworthiness, availability and dependability of technical equipment, giving proper consideration to cost effectiveness without degradation of mission accomplishment. (30:1-2)

c. Force Capability. Force capability is the composite of operational capability, availability (or operational readiness) and dependability, where:

> [Operational capability] is a measure of the ability of a [weapon system] to achieve mission objectives given the conditions during the mission. (6:107)
>
> Availability is a measure of the degree to which an item is in an operable and committable state at the start of the mission when the mission is called for at an unknown (random) time. (11:1)
>
> Dependability is a measure of the item operating condition at one or more points during the mission, including the effects of reliability, maintainability and survivability, given the item condition(s) at the start of the mission. (11:2)

d. Logistic Support.

> Logistic support is viewed as the composite of all considerations necessary to assure the effective and economical support of a [weapon] system throughout its programmed life cycle. (2:9)

e. Organization. An organization is a social entity, which is goal-directed, has a deliberately structured activity system and an identifiable boundary (7:5).

f. Organization Structure. An organization structure:

(1) describes the allocation of task responsibilities to individuals within the organization. The structure also denotes the degree of specialization, the grouping together of individuals into departments, and the grouping of departments into the total organization;

(2) designates formal reporting relationships, including lines of authority, decision responsibility, the number of levels in the hierarchy, and the span of control of managers; and

(3) includes the design of systems and mechanisms that underlie the effective coordination of efforts among diverse individuals and departments. These systems provide for horizontal as well as vertical communication and coordination (7:361).

g. Weapon System.

> A weapon system is the weapon and those components required for its operation. It is a composite of equipments, skills and techniques that form an instrument of combat which...has an aerospace vehicle as its major operational element. The complete weapon system includes all related facilities, equipment, materiel, services, and personnel required solely for the operation of the aerospace vehicle...so that the instrument of combat becomes a self-sufficient unit of striking power in its intended operational environment. (6:711)

Purpose of the Research

The strike and reconnaissance force capability of the F/RF-111C Weapon System is to a large extent dependent on the effectiveness of logistics management (engineering, maintenance and supply management), which is provided by HQSC LOGENG Sub-Branch and other agencies within the RAAF. Since the formation of the Logistics Branch in 1983, no studies have examined the effectiveness of engineering management provided to the F/RF-111C Weapon System. The purpose of this research, therefore, was to assess the effectiveness of engineering management provided for the F/RF-111C Weapon System.

In order that the effectiveness of engineering management provided for the F/RF-111C Weapon System could be assessed, this research specifically: (1) investigated how effectiveness as applied to the engineering management of a combat weapon system can be measured, either qualitatively or quantitatively; (2) evaluated the effectiveness of

existing engineering management provided for the F/RF-111C Weapon System in terms of this effectiveness measure; (3) reviewed the sufficiency and utilization of resources applied to engineering management of the F/RF-111C Weapon System; and (4) designed an improved organization structure and division of management functions and responsibilities for engineering management of the F/RF-111C Weapon System.

Research Questions

The objective of this research was satisfied by answering the following research questions:

a. Research Question 1. Is the current level of engineering management of the F/RF-111C Weapon System satisfying force capability requirements? Related investigative questions were:

(1) Investigative Question 1a. How does engineering management contribute to the force capability of the F/RF-111C Weapon System?

(2) Investigative Question 1b. Are new or revised force capability requirements satisfied within the specified timeframe?

b. Research Question 2. Is engineering management of the F/RF-111C Weapon System being carried out in an effective manner? Related investigative questions were:

(1) Investigative Question 2a. What measures of effectiveness can be applied to engineering management of the F/RF-111C Weapon System?

(2) Investigative Question 2b. What past engineering management actions have enhanced or adversely affected the effectiveness of engineering management of the F/RF-111C Weapon System?

(3) Investigative Question 2c. How did these engineering management processes affect the effectiveness of engineering management of the F/RF-111C Weapon System?

c. Research Question 3. Are the existing organization structure, management responsibilities, and orders and instructions responsive to the engineering management requirements of the F/RF-111C Weapon System? Related investigative questions were:

(1) Investigative Question 3a. What is the organizational structure of HQSC LOGENG Sub-Branch?

(2) Investigative Question 3b. What are the current policies that relate to engineering management, as detailed in instructions, orders and regulations?

(3) Investigative Question 3c. Are there deficiencies and/or conflicts in the instructions and orders related to RAAF engineering management organization, functions and responsibilities?

(4) Investigative Question 3d. Are there other engineering management processes of weapon systems that are

applicable to, and will improve the effectiveness of, engineering management of the RAAF F/RF-111C Weapon System?

Scope and Limitations

This research specifically addressed engineering management of the F/RF-111C Weapon System during peacetime operational tasks but noted, when identified, possible inconsistencies in engineering management of this weapon system during higher levels of threat or conflict. Discussion and response to Research Question 1 concerning whether the current level of engineering management of the F/RF-111C Weapon System is satisfying force capability requirements, was limited to discussion of material that was not classified or otherwise limited in distribution.

The study of RAAF engineering management of the F/RF-111C Weapon System was limited to the following particular aspects of engineering management:

a. organization, functions and responsibilities of engineering agency responsible for engineering management of the F/RF-111C Weapon System;

b. modification management;

c. configuration management; and

d. technical publication management.

Organization design provides the allocation and structure of resources to achieve a mission (13:97); an understanding of the LOGENG Sub-Branch organization

structure is necessary to study the effectiveness of RAAF engineering management of the F/RF-111C Weapon System. The topics of modification, configuration and technical publication management were selected as these aspects have a primary impact on the success of engineering management of the F/RF-111C Weapon System.

Timeframe. This research was limited to an examination of engineering management of the F/RF-111C Weapon System between 1983 and 1989, from the creation of HQSC LOGENG Sub-Branch in 1983 to the creation of Headquarters Logistics Command (HQLC) on 28 February 1990. The creation of HQLC resulted from a structural review of AFO and devolution of additional authority and responsibility for logistics management to HQLC.

Organization of the Research

This research is presented in five major sections. Chapter I provides an overview of the RAAF organization associated with engineering management of the F/RF-111C Weapon System and then outlines the purpose of this research. Chapter II provides an explanation of the current engineering management functions and processes. The various types of organization structure and measures of organization effectiveness are also described.

Chapter III explains the methodology used in this research. A preferred organization structure and measures

of organization effectiveness appropriate to engineering management of the F/RF-111C Weapon System are developed in Chapter IV. Within the preferred organization structure, the existing orders and instructions are analyzed. Chapter V presents the conclusions and recommendations which resulted from this research.

II. Background and Literature Review

Overview

This overview was broadly divided into two areas. First, several macro-management issues were addressed:

a. the division of engineering responsibilities between organizations within the RAAF (Section I);

b. RAAF instructions, directives and publications which affect engineering management of weapon systems (Section II);

c. organization structure (Section III); and

d. measures of organization effectiveness (Section IV).

Two particular aspects of RAAF engineering management were then described: (1) modification management (Section V); and (2) configuration management (Section VI).

Section I - Division of Engineering Responsibilities

Engineering responsibilities are divided between the Engineering Division of Department of Defence (Air Force Office) (DEFAIR ENG), HQSC, and Air Headquarters Australia (AHA).

DEFAIR ENG is responsible for the formulation of RAAF engineering policy, the division of resources between new capital equipment projects and support of the force-in-

being, the establishment of priorities for financial, facilities and manpower resources and the management of new projects through to introduction into service (18:1).

HQSC is delegated the authority and responsibility for management of specific engineering functions for in-service weapon systems and other technical equipment. These engineering functions are detailed in Appendix A.

AHA is responsible [inter alia] for the following engineering functions:

a. ensuring the implementation of engineering policy promulgated by DEFAIR ENG and engineering standards promulgated by HQSC; and

b. recommending improvements to the design and performance of in-service weapon systems to ensure their maximum operational effectiveness (16:1).

Section II - Technical Instructions and Publications

Technical instructions and publications of a permanent nature for official use in the RAAF include:

a. Defence Instructions (General) - Technical;

b. Defence Instructions (Air Force) - Technical (DIs(AF) TECH);

c. Australian Air Publications (AAPs) for RAAF technical publications issued before 9 February 1976;

d. Defence Instructions (Air Force) - AAP (DI(AF) AAP) for RAAF technical publications issued after 9 February 1976; and

e. miscellaneous technical publications (22:1).

Technical instructions of an urgent, short term nature or with limited distribution include:

a. Air Force Temporary Instructions - Technical (AFTIs TECH); and

b. Air Force Technical Directives (AFTDs).

DIs(AF) TECH are the prime source of RAAF technical policies and procedures. New technical policies and procedures or variations to existing technical policies and procedures may be promulgated as AFTIs TECH pending formal issue or amendment of the appropriate DI(AF) TECH (18:1).

Australian Air Publications

Technical publications have the force and effect of Defence Instructions, and are the authority upon which technical action is taken. All technical publications are issued in the form of AAPs irrespective of the origin of the information.

HQSC is responsible for:

a. preparation of AAPs and other miscellaneous technical publications to RAAF specifications;

b. promulgation of AAPs and other miscellaneous technical publications;

c. review and assessment of requirements for, and procurement of, publications and other reports from sources outside the RAAF; and

d. distribution, amendment, retrieval and disposal of all technical publications (22:2).

Publication Sponsor. For technical equipment, the AAP sponsor is generally the SYSENG in the LOGENG Sub-Branch who directly responsible for engineering management of the technical equipment covered by the AAP.

Logistics Branch Routine Instructions

A long term goal of the HQSC Logistics Branch is to produce an RAAF Manual of Logistics which will cover all aspects of the RAAF Logistics System, and which will be directed at three levels of management: Executive, Operative, and Customer Relations. "As an interim measure, Logistics Branch Routine Instructions (LBRIs) have been produced to advise Logistics Branch staff in the day-to-day processing of logistics requirements" (28:1). The LBRIs were issued in 1983 and now comprise seven volumes, each volume relating to a specific functional responsibility within the Logistics Branch.

LBRIs - Engineering (LBRI(ENG)) are issued primarily to elaborate on policy issued by an higher authority in the form of an order or instruction. Specific functions and

responsibilities of engineering staff within the LOGENG Sub-Branch are detailed in LBRIs(ENG).

Section III - Organization Structure

Much has been written about organizations and their structures. Many have attempted to identify the 'right' organization structure, that structure that will allow an organization to maximize its effectiveness and productivity in achieving the organization's goals (7:363). But the structure of an organization assumes greater importance when the structure is incorrect. When the structure is incorrect, the organization will not achieve its goals (7:364).

Organizations

Organizational Goals. Organizations exist for a stated purpose, and organizational goals define and state that purpose. Goals serve as guides to action, as a source of motivation, as a standard of performance, to legitimize the organization, and as a rationale for internal structure and decision processes (7:319-320).

Organizations can be described in terms of two organizational dimensions - context and structure. Contextual dimensions characterize the whole organization and include the size of the organization, its organizational technology and the environment within which the organization

operates. Structured dimensions relate to the structural design of an organization and include formalization, complexity, span of control, centralization, professionalism and personnel configuration (7:218-220).

Organization Structure

Daft and Steers note that organization structure is the mechanism used to integrate the goals of an organization and the three contextual dimensions: (1) size, (2) organizational technology, and (3) environment (7:361). A goal of product innovation requires a different structure than a goal of internal efficiency. Technological complexity will also influence structure, and the extent of technical interdependence among departments within the organization will influence departmental groupings. Large size makes different demands on the structure than small size: large organizations have to consider whether to divide into autonomous divisions. Environmental change, complexity and resource dependence influence the creation of departments as well as the allocation of tasks and responsibilities, and the extent of required coordination within the organization (7:361).

Size. Large organization size is associated with greater complexity, decentralization and formalization. Greater complexity occurs because of a greater division of labor and the need for more levels in the hierarchy.

Decentralization occurs because top managers cannot handle all decisions in a large organization and specialized expertise facilitates decentralized decision making. Formalization provides an impersonal way to standardize and regulate behavior and activities in a large, diverse organization system (7:225-227).

Organizational Technology. Technology is the knowledge, tools, techniques and behaviors used to transform organizational inputs into organizational outputs (7:219).

Environment. The environment is all those elements which exist outside the boundary of the organization and that have the potential to affect the organization. The environment includes the elements of competition, resources, technology, economic conditions, and other elements related in some way to the organization. The two types of environments are: (1) the task environment, which refers to those parts of an organization's external environment that are directly related to goal setting and attainment; and (2) the general environment, which refers to those parts of the environment that affect the organization indirectly or infrequently. The reason for the organization's existence is the external environment, and the organization cannot succeed without being cognizant of and responsive to its external environment (7:286-287).

Alternative Organization Structures

Daft and Steers identify four generic types of organization structure: (1) functional structure, (2) self-contained unit structure (also called a decentralized structure), (3) hybrid structure, and (4) matrix structure (7:365). All four structures are designed to achieve the objectives of a company, and each structure provides a number of strengths and weaknesses. In developing the most appropriate organization structure, the objectives of organizational design should undertake to minimize the effect of the weaknesses inherent in the organization structure selected (13:98).

Functional Structure. In a functional organization structure, the specialization is by function - employees are grouped together according to similar task and resources (7:366). The functional structure tends to centralize decision making, because the point at which the functions converge is at the top of the organization. The key strengths of the functional organization are that it supports in-depth skill development and a simple decision-communication network. However, the primary weakness of a functional organization structure is that when the organization's environment becomes more dynamic and uncertainty increases, many decisions filter to the top of the organization: lower-level managers do not have the necessary information for decision making and top-level

managers become overloaded. The overall effect is that organization is slow to respond to the changes in the environment. Also, responsibility for performance is difficult to identify. Organizational performance is made up of activities in each of the separate departments; the contribution of each department may not be identifiable (7:369). The characteristics, strengths and weaknesses of a functional organization structure are compared in Table 1.

Self-Contained Unit Structure. In a self-contained unit structure, the specialization is by product or service (7:369). Each division or section has all the functions and resources necessary to produce a product or service; managers do not have to compete for shared resources as required in a functional organization structure. There is also full-time commitment to the product or service. This type of organization structure is particularly effective when the organization's environment is very complex, and the environment can be segmented into products or services around which the organization can structure itself (7:372-373). Segmentation of products or services provides increased specialization and reduces the amount of information required in decision making. The major weakness of a self-contained unit structure is the duplication of functions and resources (7:374). The characteristics,

Table 1: Characteristics, Strengths and Weaknesses of Organization Structures
(adapted from 7)

When to Use	Strengths	Weaknesses
Functional Structure		
1. Stable, certain environment	1. Efficient use of resources	1. Poor coordination across functions
2. Small-medium size	2. In-depth skill development	2. Decisions pile on top
3. Routine technology, interdependence within	3. Career progress based on functional expertise	3. Slow response, little innovation
4. Goals of efficiency, technical quality	4. Central decisions and direction	4. Responsibility for performance difficult to pinpoint
	5. Excellent coordination within functions	5. Limited general management training
Self-Contained Unit Structure		
1. Unstable, uncertain environment	1. Fast change in an unstable environment	1. Duplication of resources
2. Large size	2. Client focus and satisfaction	2. Less technical specialization and expertise
3. Technological interdependencies between functions	3. High coordination between functions	3. Poor coordination across product lines
4. Goals of product specialization, innovation	4. Responsibility and control for multiple products	4. Less top management control
	5. Develops general managers	
	6. Product goal emphasis	

Table 1 (continued): Characteristics, Strengths and Weaknesses of Organization Structures

When to Use	Strengths	Weaknesses
Hybrid Structure		
1. Unstable environment, especially in customer/ competitor sectors	1. Provides coordination within and between product divisions	1. Conflict between corporation and divisions
2. Large size	2. Alignment between corporate and division goals	2. Administrative overhead
3. Technological interdependencies with both functions and product lines	3. Helps organization attain adaptability in some departments and efficiency in others	
4. Goals of product specialization and adaptation, plus efficiency in some functions		
Matrix Structure		
1. Very uncertain, shifting environment	1. Can manage dual demands from environment	1. Dual authority cause frustration and confusion
2. Medium-large size	2. Flexible, efficient use of scarce resources	2. High conflict
3. Nonroutine technology, high interdependence	3. Adaptation and innovation	3. Time consuming
4. Dual goals of product and functional specialization	4. Development of functional and general management skills	4. Special training required
		5. Difficult to maintain power balance

strengths and weaknesses of a self-contained organization structure are compared in Table 1.

Hybrid Structure. The hybrid structure contains elements of both functional and self-contained unit organization structures. The organization has self-contained product or service divisions, but some functions are maintained as centralized functional divisions within the organization. The hybrid organization structure provides the advantages of the self-contained unit structure by allowing management of specific functions as orientated in a product or service division, and centralizes the remaining functions whose activities require greater specialization or training, or to achieve economies of scale (7:376-378). The characteristics, strengths and weaknesses of a functional organization structure are compared in Table 1.

Matrix Structure. The unique aspect of a matrix organization structure is that both functional and product structures are implemented simultaneously by creating a dual hierarchy that affects each division within the organization (7:380). Product managers and functional managers have equal authority and responsibility within the organization. The matrix structure relies on the inherent conflict of interests between functions and products to provide the necessary information for responsive decision making in an uncertain environment (7:382). The characteristics,

strengths and weaknesses of a functional organization structure are compared in Table 1.

Symptoms of an Incorrect Organization Structure

The importance of an organization structure is realized when the structure is inappropriate to the goals and objectives of the organization, and adversely affects the organization's performance.

When organization structure is incorrect:

a. the organization does not respond quickly or innovatively to environmental changes;

b. managerial decision making may be delayed or lack in quality;

c. too much conflict will be evident; and

d. the organization will not achieve performance goals (7:363-364).

Current HQSC LOGENG Sub-Branch Organization Structure

HQSC LOGENG Sub-Branch is responsible for engineering management of the F/RF-111C Weapon System and other combat weapon systems. The current organization structure of HQSC LOGENG Sub-Branch, as it applies to the F/RF-111C Weapon System, is detailed in Figure 2. Responsibilities of LOGENG Sub-Branch sections are detailed in Table 2.

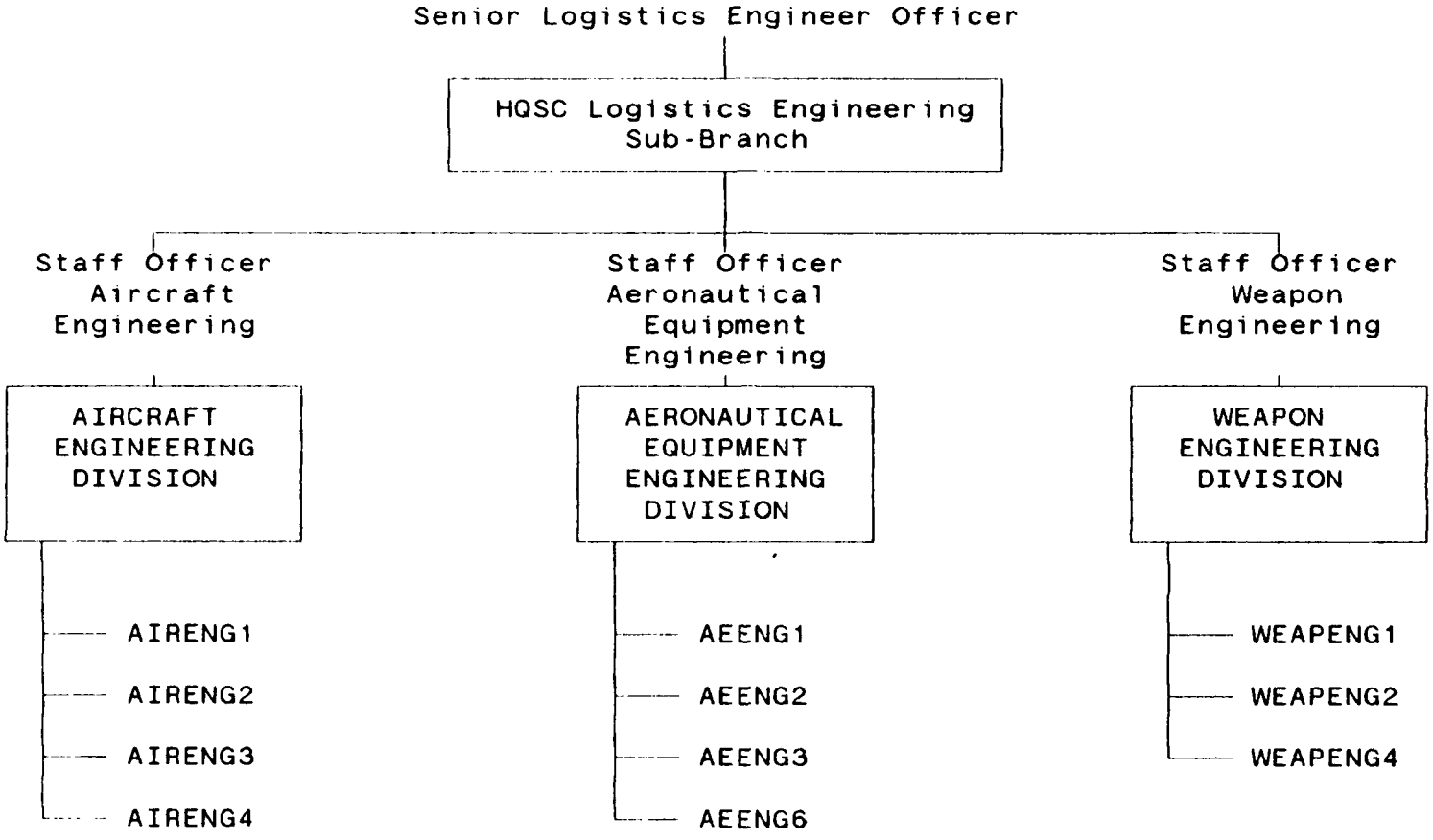

Figure 2: Existing HQSC LOGENG Sub-Branch Organization - F/RF-111C Weapon System

Table 2: HQSC LOGENG Sub-Branch Section Division of Responsibilities

Section	Responsibility
AIRENG1	Aircraft systems; safety and survival equipment.
AIRENG2	Engines and engine systems.
AIRENG3	Maintenance engineering analysis; servicing schedules; technical maintenance plans; technical substitution.
AIRENG4	Fuels, lubricants and chemicals; non-destructive inspection and early failure detection; materials and processes; aircraft weight and balance; aircraft structures and fatigue analysis.
AEENG1	Instrument systems; flight simulators, synthetic navigation trainers and operational flight trainers.
AEENG2	Electrical systems.
AEENG3	Radar systems and airborne telecommunication systems.
AEENG6	Automatic test equipment and ground support equipment.
WEAPENG1	Aircraft ordnance systems.
WEAPENG2	Airborne guided systems.
WEAPENG4	Aircraft emergency egress systems.

Organizational Goal. The organizational goal of the HQSC LOGENG Sub-Branch is:

> To preserve or improve the asset to the maximum extent possible by engineering and maintenance actions within the limits of available resources and consistent with RAAF requirements. (5)

Size. HQSC LOGENG Sub-Branch is a relatively large organization with a staff of 604 personnel, of which over 89% are RAAF Engineer Officers or technical trades Airmen (as of 1 November 1989); approximately 62 man-years per year are dedicated to engineering functions for the F/RF-111C Weapon System (5). The organization is complex with six major divisions and 19 sections. The organization is highly formalized with instructions, directives and publications.

Organizational Technology. The organizational inputs include operational requirements for the introduction or improvement of an operational capability, and engineering requirements either sourced from within HQSC LOGENG Sub-Branch or resulting from deviations of the F/RF-111C Weapon System from its technical specifications. The knowledge used to transform these organizational inputs comes from the professional training and expertise of the engineering personnel. HQSC LOGENG Sub-Branch is placing increasing emphasis on decision support systems and management information systems for both routine and non-routine technologies.

Environment. The task environment of HQSC LOGENG Sub-Branch's engineering management of the F/RF-111C Weapon System includes AFO, other sub-branches within HQSC Logistics Branch, and SRG. SRG can be considered to be the customer of HQSC LOGENG Sub-Branch within the scope of the task environment. Within the general environment, HQSC

LOGENG Sub-Branch is affected by the level of threat to the security of Australia and its strategic interests, the sociopolitical fabric of the Australian people and the competition for finite budgetary resources with other Federal Government priorities.

The concept behind the current organization structure of HQSC LOGENG Sub-Branch dates back to the end of World War II. During this period, the Technical Services Division of the RAAF had technical responsibility for all RAAF combat weapon systems. This division utilized a functional organization structure based on the type of subsystem installed in period aircraft: airframe, engine, instrument, electrical, and radio systems and equipments. This organization structure was appropriate when aircraft systems were relatively independent of one another and had a reduced level of technical complexity.

With the introduction of the F/RF-111C aircraft into operational service in 1973, HQSC LOGENG Sub-Branch undertook engineering management responsibility for one of the most technologically complex systems ever designed. Management within HQSC LOGENG Sub-Branch experienced difficulty in utilizing the existing functional organization structure and a dedicated F/RF-111C aircraft engineering management cell was established, drawing together all the dispersed functions into an integrated 'product' cell.

After approximately one year as a product cell, engineering management of the F/RF-111C Weapon System was re-dispersed into the existing functional organization structure. This occurred for a number of reasons: (1) higher level management had determined that the personnel originally formed into the product cell had sufficient experience and understanding of the weapon system; and (2) with a posting cycle of two years for engineering personnel, management placed higher emphasis on developing expertise in the functional areas at the expense of managing each weapon system as an integrated system (16).

The weaknesses associated with a functional structure have become more pronounced in recent years as the initial cadre of experienced personnel have resigned from the Service and because of a lack of emphasis on the requirement for potential employees to have the proper training and experience with the F/RF-111C Weapon System. Less experienced personnel did not comprehend the level of integration of systems in the F/RF-111C Weapon System and the essential need to coordinate activities when the 'functional' systems interrelated with other systems. For example, F-111C Modification 7214.003-345 was developed to install an Attitude Indicator Monitor Unit in the aircraft. The modification required that this unit be installed in the same location that avionic equipment from F-111C Modification 7214.003-400 was installed. Modification

7214.003-345 was installed in several aircraft before the conflict was realized. The result of the lack of coordination caused a significant workload in the LOGENG Sub-Branch, and 482SQN and 3AD.

When engineering responsibility for the PAVE TACK/ Guided Weapons System (PT/GWS) was delegated from AFO to HQSC in 1985, the complexity of subsystems within the PT/GWS prevented apportionment of responsibilities based on traditional functional responsibilities. The eventual division of responsibilities, in attempting to align with the functional division of the organization structure, split responsibility for several PT/GWS subsystems between functional cells. For example, the Harpoon Anti-Ship Missile System is a subsystem of the PT/GWS, and consists of the Harpoon Control Panel (HCP), Harpoon Interface Unit (HIU) and interfaces to the Harpoon Missile through the weapon system Control Program Unit and Station Program Unit. AEENG1 is responsible for engineering management of the HIU and AEENG2 is responsible for engineering management of the HCP.

These examples highlight the major weakness associated with the existing functional organization structure of HQSC LOGENG Sub-Branch - the difficulty in coordinating engineering requirements for the F/RF-111C Weapon System across several functional areas of responsibility within

HQSC LOGENG Sub-Branch. The immediate result of coordination difficulties is not meeting the requirements of the customer (SRG) and in the general environment, not being able to provide the most capable logistics engineering infrastructure to support the strike and reconnaissance force capability and protection of Australia's interests.

Engineering Management of F/A-18 Weapon System. With the introduction of the F/A-18 Weapon System into operational service in 1987, HQSC LOGENG Sub-Branch unsuccessfully attempted to manage this weapon system along similar functional divisions of responsibility. The Hornet Avionics Section was formed in 1987, consolidating the functions and responsibilities of AEENG1, AEENG2 and AEENG3. The Hornet Engineering Section was formed in 1988, and grouped together the primary functional areas of engineering management (AIRENG1, WEAPENG1 and the Hornet Avionics Section) into a single product oriented engineering cell.

Section IV - Measures of Organization Effectiveness

Anthony and Herzlinger (1:227) identify that output information is required for two purposes: (1) to measure efficiency, which is the ratio of outputs to inputs; and (2) to measure effectiveness, which is the extent to which actual output corresponds to the organization's goals and objectives.

Recall that goals define and state the purpose of an organization. Goldratt has a very straightforward concept of the goal of a private sector firm. The goal of that firm is to make money (15:21). Measures of corporate effectiveness, such as net profit, return on investment, and cash flow, reflect this goal of making money. In a profit-oriented organization, net profit is used as a measure of both efficiency and effectiveness.

By definition, profit cannot be an objective of non-profit organizations, such as the Federal Government and it departments (1:31). Therefore a government department must have other non-profit goals. The goal of the Australian Defence Force, for example, can be described as maintaining and developing capabilities for the independent defence of Australia and promoting strategic stability and security in Australia's region of strategic interest (9:1). This goal is not as easy to define and quantify as is profit for private sector organizations. Thus, in a non-profit organization that does not have revenues, an alternative means of measuring output has to be used so that a measure of effectiveness can be developed and applied.

Actual output of an organization should be related to that organization's goals and objectives (1:228). The purpose of a statement of goals is to communicate top management's decisions about the aims and relative priorities of the organization, and to provide general

guidance as to the strategy that the organization is expected to follow (1:228). The goal of the HQSC Logistics Branch "is to provide quality logistics support for RAAF and assigned ADF operations" (17:3). This goal and the goal of the LOGENG Sub-Branch are statements of intended output in relatively broad terms. They have not been related to a specific time period. These goals are not quantified and therefore cannot be used directly as a basis for an effectiveness measurement system.

Organization Objectives

An objective is a specific result to be achieved within a specified timeframe, usually in a period less than two years (1:230). A statement of objectives is a key element in any measure of effectiveness, as an organization's effectiveness can be measured only if the actual outputs are related to objectives. An objective should be stated in measurable terms - be quantifiable. If a particular objective can not be measured, the objective should be precisely stated so that a subjective assessment could judge whether that objective has been achieved (1:230).

Measurement Categories

Anthony and Herzlinger explain that measurement categories can be divided into two types: (1) results measures; and (2) process measures (1:232).

Results Measure. A results measure is a measure of output expressed in terms that are related to an organization's objectives (1:232). This assumes that the objective can be stated in measurable terms and that the output can be measured in these same terms. If an organization is customer oriented, then a results measure relates to what the organization did for the customer.

Process Measure. A process measure relates to an activity carried on within the organization (1:232). Examples would include the number of defect reports processed per week, or the number of modification orders issued in a year. Process measures are the easiest type of output measure to interpret, but they measure efficiency and not effectiveness (1:233).

The essential difference between a results measure and a process measure is that the former is 'ends oriented' while the latter is 'means oriented'. An ends-oriented indicator is a direct measure of success in achieving an objective. A means-oriented indicator is a measure of what an organization does. There is an implicit assumption that what the organization does helps to achieve the organization's objectives, which may not always be a valid assumption. For example, the number of maintenance errors caused by inaccurate technical data is an ends-oriented results measure, while the number of technical publication updates processed is a means-oriented process measure. The

implication of a causal relationship between the number of technical publication updates processed and the number of maintenance errors (due to inaccurate technical publications) may or may not be valid.

Process measures can lead to ineffective performance if they are unrelated to performance measures. For example, if a squadron was able to achieve its monthly flying rate (by flying in large circles around their homebase), the squadron may not achieve any real accomplishments if, for instance, its role was close air support.

Productivity. Productivity is the output per unit of input, and the inputs in this ratio should include all the resources used to achieve the output. More commonly and especially in processes where skilled labor is the critical resource or the process constraint, productivity usually refers to the quantity of output per man-hour or man-year (1:233). This interpretation of productivity assumes that the level of all other resources remains constant.

Other Characteristics of Output Measures

Other characteristics of output measures include whether the measure is:

a. subjective or objective,

b. quantitative or qualitative, and

c. discrete or scalar (1:237-240).

An output measure may result from the subjective assessment of a person or group of persons, or it may be derived from data that are not dependent on human judgment. A judgment made by a qualified person is usually a better measurement of the quality of performance than any objective measurement, because humans can incorporate in their judgment the effect of circumstances and details of performance that objective measures can not take into account. Subjective judgments are, however, just that: they depend on the person making the judgment and may be affected by that person's prejudices and attitudes. Objective measurements, if derived properly, do not have these faults.

Performance has both a quantity and quality dimension. Usually it is more feasible (or easier) to measure quantity (for example, the number of modification orders issued) than to measure quality (for example, how incorporation of the modification orders impacted the airworthiness of a particular weapon system). However, the indicator that is chosen to measure quantity often implies some standard of quality. When a modification order is issued, the implicit assumption is that incorporation of the modification order does not adversely impact the airworthiness or performance of a weapon system.

Importance of Quality. In a nonprofit organization, measures of quality tend to assume greater importance than in a profit-oriented company (1:240). In a profit-oriented

company, consumers' acceptance or rejection of a product provides an automatic check on the quality of the product. There is no such mechanism for adverse customer reaction to the output of many nonprofit organizations, especially when instructions and orders provide the customer with no other choice.

Selection of Output Measures

Anthony and Herzlinger identify several propositions that are relevant in considering measures of effectiveness for a non-profit organization:

a. some measure of output is better than none;

b. use measures that can be reported in a timely manner;

c. focus on important measures; and

d. do not report more information than is likely to be used (1:242).

Section V - Modification Management

The modification of RAAF technical equipment is the process of altering the equipment to conform to an approved change. The requirement to modify technical equipment arises primarily from imperfections in the equipment, or the need to take advantage of latest developments which will result in improved operational effectiveness (23:1).

HQSC authorizes all modifications to technical equipment by the issue of modification orders, which are published in the appropriate publication pertaining to each technical equipment.

Outline of the Modification Process

When a requirement for a modification is envisaged, or a need has become apparent from information received from other operators of the technical equipment, contractors, defect reports or other sources, a funds estimate to cover the anticipated costs of the proposed modification is submitted for inclusion in the LOGENG Sub-Branch financial estimates, which form part of the annual Defence budget.

The proposed modification must initially be evaluated for design, engineering, cost and development factors, and its effect on other agencies such as operational staff, maintenance, supply support and training must be considered (28:3). When the need for a modification has been established, the proposed modification must be endorsed by operational staff if the modification will affect aircraft performance or cockpit configuration and then submitted for technical and financial approval.

Following technical and financial approval of the modification, modification kits and spares are procured, amendments are raised to the affected technical publications and engineering drawings, and the modification order is

issued (28:3). The modification order is issued as an amendment to the appropriate technical publication.

Instructions and Publications

Instructions and publications which are related to the modification of RAAF technical equipment are detailed in Appendix B.

Origin of Modifications

The origin of a proposed modification is important since the design competency of the proposing organization must be assessed (28:4). Modification proposals can come from:

a. the manufacturers of the technical equipment, via service bulletins;

b. AFO, HQSC and AHA;

c. contractor Engineering Change Proposals (ECPs); or

d. other Services and international regulatory agencies.

Evaluation

On receipt of information concerning the proposed modification, the SYSENG is to establish if the proposed modification:

a. is applicable to RAAF aircraft or equipment, or other Australian Defence Force aircraft or equipment;

b. is economic;

c. is of an improved, acceptable design;

d. has engineering integrity;

e. can be adequately supported with spares;

f. can be readily developed;

g. is worthwhile after life of type (or life cycle cost) factors have been considered;

h. is feasible after advice from the Australian Department of Aviation and US Federal Aviation Administration has been given, if required; and

i. has AFO operational requirements staff approval where operational aspects of the aircraft's performance or cockpit configuration are to be changed (28:4).

Classification of Modifications

Modifications to RAAF technical equipment are classified by the SYSENG according to circumstances and the required urgency of incorporation. The classes of RAAF modifications are detailed in Appendix C.

Section VI - Configuration Management

Configuration management provides a systematic means of formalizing the activities of those organizations involved in the design, development, production, procurement, modification, operation and maintenance of technical equipment (24:24-1).

The procedures needed to control configuration and manage technical equipment are detailed in a Configuration Management Plan (Air Force) (CMP(AF)). The CMP(AF) outlines the extent of configuration management and control required over technical equipment during its life cycle and specifies any particular arrangements or requirements needed to make the plan work:

> Failure to initiate or implement an CMP(AF) can have adverse effects on the ability of engineering and maintenance elements of the RAAF to maintain technical equipment so that it continues to meet operational requirements. (21:1)

Configuration Record. A configuration record forms the foundation for effective configuration management. On acceptance into the RAAF, the configuration record consists of the master engineering drawing set, specification design data, test results and technical publications. The configuration of the weapon system is then maintained to the extent necessary to ensure that the equipment continues to meet the operational requirement. When the weapon system is modified as a result of an operational requirement to improve its operational capability or for other technical requirements, concurrent changes must be made to the baseline configuration record of the affected weapon system (21:1).

Summary

Engineering responsibilities for the F/RF-111C Weapon System are divided between DEFAIR ENG, AHA and HQSC. DIs(AF) TECH are the prime source of RAAF technical policies and procedures and are supplemented by RAAF AAPs. Within the HQSC LOGENG Sub-Branch, LBRIs(ENG) provide specific guidance on implementation of RAAF engineering policy.

Organizational goals state the purpose of an organization. The structure of an organization integrates the goals of an organization with its size, organizational technology and its environment. Alternative organization structures include a functional structure, a self-contained unit structure, a hybrid structure and a matrix structure. The HQSC LOGENG Sub-Branch is a relatively large organization with a functional organization structure based on the type of subsystem installed in aircraft.

An organization's effectiveness is the extent to which its actual output corresponds to the organization's goals. Measures of corporate effectiveness such as net profit cannot be the objective of a non-profit organization. The goal of the HQSC LOGENG Sub-Branch is relatively broad and not related to a specific period of time. The goals are not quantified and therefore cannot be used directly as a basis for an effectiveness measurement system.

An objective is a specific result to be achieved within a specified timeframe and is a key element in any

measure of effectiveness. Thus, an objective must be measurable either objectively or subjectively.

Two specific aspects of RAAF engineering management - modification management and configuration management - were then described.

III. Methodology

Overview

The primary objective of this research was to determine if engineering management of the F/RF-111C Weapon System is being provided in the most effective manner possible. To achieve this objective, the research was conducted in three phases: (1) a review of available literature was conducted to determine the current engineering management processes of RAAF F/RF-111C Weapon System; (2) deficiencies in existing engineering management processes of the F/RF-111C Weapon System were identified, based on the previous experience of the author and through telephone interviews with selected engineering personnel at AFO, HQSC LOGENG Sub-Branch, SRG, and TLO SM-ALC; and (3) alternative engineering management processes, derived from the telephone interviews and the author's personal experience, were evaluated to determine whether these processes would overcome deficiencies in the existing engineering management of the RAAF F/RF-111C Weapon System.

The methodology of addressing the research questions, stated with their respective investigative questions in Chapter I, is discussed in the remainder of this chapter. First, the relationship between each phase of the research and the research questions is described. The pretesting and conduct of the telephone interviews for this research,

including the limitations of this interview process, are then explained.

Research and Investigative Questions

To accomplish the research process and respond to the management question, three research questions were developed. More specific investigative questions were then developed in order to respond to each research question. The three research questions and their associated investigative questions are restated in the following paragraphs.

Research Question 1. Is the current level of engineering management of the F/RF-111C Weapon System satisfying force capability requirements? Related investigative questions were:

a. Investigative Question 1a. How does engineering management contribute to the force capability of the F/RF-111C Weapon System?

b. Investigative Question 1b. Are new or revised force capability requirements satisfied within the specified timeframe?

Research Question 2: Is engineering management of the F/RF-111C Weapon System being carried out in an effective manner? Related investigative questions were:

a. Investigative Question 2a. What measures of effectiveness can be applied to engineering management of the F/RF-111C Weapon System?

b. Investigative Question 2b. What past engineering management actions have enhanced or adversely affected the effectiveness of engineering management of the F/RF-111C Weapon System?

c. Investigative Question 2c. How did these engineering management processes affect the effectiveness of engineering management of the F/RF-111C Weapon System?

Research Question 3: Are the existing organization structure, management responsibilities, and orders and instructions responsive to the engineering management requirements of the F/RF-111C Weapon System? Related investigative questions were:

a. Investigative Question 3a. What is the organizational structure of HQSC LOGENG Sub-Branch?

b. Investigative Question 3b. What are the current policies which relate to engineering management, as detailed in instructions, orders and regulations?

c. Investigative Question 3c. Are there deficiencies and/or conflicts in the instructions and orders related to RAAF engineering management organization, functions and responsibilities?

d. Investigative Question 3d. Are there other engineering management processes of weapon systems that are

applicable to, and will improve the effectiveness of, engineering management of the RAAF F/RF-111C Weapon System?

These questions will be addressed by three distinct phases of the methodology.

Methodology - Phase 1

A review of the available literature was used to address four specific investigative questions. These questions were:

a. Investigative Question 1a. How does engineering management contribute to the force capability of the F/RF-111C Weapon System?

b. Investigative Question 2a. What measures of effectiveness can be applied to engineering management of the F/RF-111C Weapon System?

c. Investigative Question 3a. What is the organization structure of HQSC LOGENG Sub-Branch?

d. Investigative Question 3b. What are the current policies which relate to engineering management, as detailed in instructions, orders and regulations?

Literature Review. The F-111 weapon system is operated by the RAAF and USAF. The current engineering management processes were readily obtainable from RAAF instructions and publications. The organizational structure of HQSC LOGENG Sub-Branch was obtained from organizational charts. US Defense Technical Information Center (DTIC) sources were

searched for any past F-111 weapon system studies. No studies have examined the effectiveness of existing RAAF and USAF engineering management procedures; previous studies have examined specific aspects of engineering management of USAF weapon systems, particularly the USAF modification process. This initial search was then expanded to include topics related to engineering management for all aerospace vehicle weapon systems: configuration control, configuration management, modifications, modification management, and systems management. The searches were limited to research reports and studies published since 1973 for the following reasons:

a. the F/RF-111C Weapon System was introduced into the RAAF operational inventory in 1973; and

b. the USAF F-111 test program and rectification of initial structural failures was not completed until 1973.

Methodology - Phase 2

Deficiencies in the existing engineering management processes of the RAAF F/RF-111C Weapon System were identified in the second phase. The deficiencies were determined by a descriptive analysis of the current HQSC LOGENG Sub-Branch engineering management processes as detailed in relevant RAAF instructions and orders. The analysis was based on the researcher's experience (five years of employment within HQSC LOGENG Sub-Branch as a

Systems Engineer (SYSENG) and Sub-Section Head responsible for avionic subsystems of the F/RF-111C Weapon System during the period 1984-89), and through telephone interviews with selected engineering personnel in AFO, HQSCLOGENG, SRG and TLO SM-ALC.

The following investigative questions were answered:

a. Investigative Question 1b. Are new or revised force capability requirements satisfied within the specified timeframe?

b. Investigative Question 2b. What past engineering management actions have enhanced or adversely affected the effectiveness of engineering management of the F/RF-111C Weapon System?

c. Investigative Question 2c. How did these engineering management processes affect the effectiveness of engineering management of the F/RF-111C Weapon System?

d. Investigative Question 3c. Are there deficiencies and/or conflicts in the orders and instructions related to RAAF engineering management organization, functions and responsibilities?

Methodology - Phase 3

Alternative engineering management processes were identified in the third phase. The alternative processes were identified by the interview respondents and the researcher, and then compared with the current engineering

management processes and its deficiencies. This identification and comparison of alternative engineering management processes allowed the following investigative question to be answered:

a. Investigative Question 3d. Are there other engineering management processes of weapon systems that are applicable to, and will improve the effectiveness of, engineering management of the RAAF F/RF-111C Weapon System?

Interview Limitations

The purpose of the interviews was to: (1) verify that the published instructions, orders and regulations were being complied with in practice; (2) confirm the perceived deficiencies of current engineering management processes identified in Chapter II; (3) highlight other deficiencies of current engineering management processes; and (4) solicit concepts of alternative engineering management processes that would improve the effectiveness of engineering management of the F/RF-111C Weapon System. Accordingly, those personnel selected for the interviews were required to have personal experience in engineering management of the F/RF-111C Weapon System, in the areas of policy formulation and/or actual engineering management.

The RAAF placed a limit of 35 personnel on the sample size to be interviewed for this research (of a total population of 604 personnel with 62 man-years per year

committed to engineering functions for the F/RF-111C Weapon System). The sample population was selected from RAAF engineering personnel (officers and airmen) responsible for engineering management of the F/RF-111C Weapon System from AFO, HQSC LOGENG Sub-Branch, SRG (1SQN, 6SQN, and 482SQN), 3AD and TLO SM-ALC. Their relevant experience is detailed in Appendix D. Although it would have been desirable for all the respondents to have direct experience with engineering management of the F/RF-111C Weapon System over the six year period of this research, all personnel were directly responsible for some aspect of engineering management at the time of the interview, and all personnel had at least two years experience with engineering management of the F/RF-111C Weapon System.

Because of the distance involved in interviewing the respondents, the interviews were conducted by telephone. There are certain recognized limitations of telephone interviews. The two major limitations are: (1) the length of the interview can be limited by a respondent's interest in the research topic; and (2) it is not possible to use illustrations to explain or reinforce a point (14:171).

The limitation of the respondents' interest was obviated by their professional interest as part of the team that keeps the F/RF-111C aircraft flying. The limitation of not being able to use illustrations was negated by

transmitting the interview questionnaire to respondents before the actual interview was conducted. This also allowed the respondents to prepare their responses and thus provide more considered input to this research.

Another recognized limitation of the telephone interview research technique - that respondents must be available by telephone - was assured during pre-interview notification conversations.

Pre-Test Interview

The pre-test questionnaire is attached at Appendix E. A pre-test of the interview questionnaire was conducted to establish the content validity of the questionnaire. Content validity is the extent to which a measuring instrument provides adequate coverage of the topic under research (16:95).

The initial interview questionnaire was critiqued by five RAAF engineering personnel in HQSC LOGENG Sub-Branch. The personnel selected to critique the interview questionnaire have all had at least five years experience with engineering management of the F/RF-111C Weapon System. The measurement questions within the interview questionnaire which were reported to be difficult, ambiguous or inconsistent were either revised or replaced.

Interview Questionnaire

The interview questionnaire, amended to include the changes identified during the interview pre-test, is attached at Appendix F. The interviews were conducted by telephone during the period June 1990.

Analysis of Interview Results

Statistical analysis of responses to the two-point rating scale questions in the interview questionnaire at Appendix F is not warranted. Affirmative responses to these questions will be recorded in Chapter IV as a per cent of the interviewed population.

Common responses to the descriptive questions and other comments provided by the majority of interviewees will be included in Chapter IV in a summarized form. Respondents' inputs coupled with the researcher's experience will then form the basis of the analysis in Chapter IV.

Summary

The purpose of this chapter was to explain the methodology used to answer the three research questions posed in Chapter 1. The following methods were used:

a. review of RAAF instructions and publications and other literature, and

b. formal interviews with RAAF personnel responsible for engineering management of the F/RF-111C Weapon System.

IV. Findings and Analysis

Overview

This chapter reports the findings of this research and provides an analysis of the interview results and other data collected in support of the study. The results of the formal interviews are summarized first. The interview results, in conjunction with the background data detailed in Chapter II, are then used to address the thesis research questions.

Section I - Interview Questionnaire

The purpose of the interviews was to seek the professional opinions of selected RAAF Engineer Officers and technical trades Airmen on the effectiveness of engineering management of the F/RF-111C Weapon System. The interview questionnaire addressed the following areas of engineering management: (1) previous experience and training, (2) organization structure, (3) measures of organization performance, (4) modification management, (5) configuration management, and (6) technical publication management. The interview respondents were also given the opportunity to raise other aspects of engineering management of the F/RF-111C Weapon System.

Pre-Test Interview

The pre-test interview questionnaire is detailed in Appendix E. The following changes were made as a result of discussions with RAAF engineering personnel identified in Appendix D:

a. adding an additional question in 'Previous Experience and Training' section to address the adequacy of the HQSC Logistics Branch and HQSC Logistics Engineering Sub-Branch introductory courses;

b. adding an additional question in Section 1 'Organization Structure' to identify advantages of the existing organization structure;

c. removing Question 4.2 as it was considered redundant; and

d. including an additional section allowing respondents to provide comments on other aspects of engineering management of the F/RF-111C Weapon System that are not specifically addressed by this research.

Interview Questionnaire

The interview questionnaire which includes these changes is provided at Appendix F.

Section II - Interview Responses

The interview respondents are listed in Appendix D and the results of the interview are summarized in the following paragraphs.

Previous Experience and Training

Only one of the seven respondents (14 percent) who are currently SYSENGs has had previous HQSC LOGENG Sub-Branch experience. All respondents who hold upper and middle level management positions (Division Head, Section Head and Sub-Section Head) have had previous HQSC LOGENG Sub-Branch experience. Eleven of the nineteen respondents (58 percent) who are currently employed in the HQSC LOGENG Sub-Branch had previous F/RF-111C Weapon System unit level engineering or maintenance experience.

The respondents noted that the following factors are relevant to previous experience and training:

a. There was little opportunity for respondents to complete the courses annotated on their duty statement after they had reported for duty because of the workload and restrictions on temporary duty funds. Of those courses that are specific to the F/RF-111C Weapon System, 94 percent of the courses completed by the respondents were completed before reporting for duty.

b. The introductory HQSC Logistics Branch and HQSC LOGENG Sub-Branch courses were viewed by all SYSENGs as

inadequate. The courses attempted to provide a detailed overview of the Logistics Branch/LOGENG Sub-Branch including specific functions and responsibilities in a three day period. One SYSENG was nominated as the instructor for one block of the introductory HQSC LOGENG Sub-Branch course although he had just recently been posted into his appointment with no prior HQSC LOGENG Sub-Branch experience. He suggested that his nomination was an 'expected' secondary duty as one of the junior officers in his Section and the most recently arrived. He was required to provide instruction to other new students on one specific topic of engineering management (STIs) with initially no experience in this topic.

Organization Structure

Two of the 35 respondents (6 percent) have previously undertaken formal courses which addressed organizations, organization design and structures. All respondents were able to recall instances when engineering management of the F/RF-111C Weapon System was hindered by the current organization structure.

Respondents cited numerous examples where an HQSC LOGENG Sub-Branch response to SRG elements was delayed because of the additional management effort, resources and time required to coordinate and consolidate individual

Section responses. Several examples cited by respondents include:

a. 482SQN Avionics Engineering Section (AVES) can be tasked by any Section. A Section would rarely consult with another Section to determine the relative priority of this task compared with other tasks placed on 482SQN AVES. As a result, 482SQN would receive conflicting task requirements in terms of unit resources and task urgency and have to seek a relative priority listing of all current HQSC LOGENG Sub-Branch tasking. Parochial interests aligned along Section requirements had also created conflict between Sections.

b. Sections which have responsibility for engineering management of the majority of an avionic subsystem tended not to consult with other Sections which had engineering management responsibility for a component of that avionic subsystem.

c. One Section with responsibility for the Automatic Flight Control System (AFCS) did not take into account the resultant effect a modification to the AFCS would have on the Terrain Following Radar System, which receives a redundant attitude reference from the AFCS and is the responsibility of a second Section. The lack of knowledge of subsystem integration (resulting from lack of training) and lack of coordination between Sections allows the

possibility that the airworthiness of the F/RF-111C Weapon System could be adversely affected.

d. Daily coordination of HQSC LOGENG Sub-Branch responses to SRG requests requires additional management oversight and delays each response.

Thirty one respondents (89 percent) noted that HQSC LOGENG Sub-Branch's ability as an organization to effectively respond to SRG's requirements was made more difficult by the current organization structure and the inappropriate division of responsibilities which split responsibility for subsystems among different Sections.

While recognizing that the existing organization structure supported retention of specialist skills, all Electronic category Engineer Officers (25 of 35 respondents) believed that the importance of specialist skills had diminished with the amalgamation of three Engineer Officer categories (Radio, Instrument and Electrical) into the Electronic category in 1989. Coupled with this amalgamation of categories was the increased emphasis placed by the RAAF on career streaming by weapon system rather than by specific subsystem technical expertise. Over 76 percent of the respondents noted that those areas of engineering management which required formal graduate level training, such as airframe fatigue and structural analysis, should be retained as a functional area of any proposed organization structure. Respondents provided two reasons: (1) the relative small

size of the RAAF fleet; and (2) the small number of Engineer Officers who were receiving or were likely to receive the expensive and necessary training.

Nearly 89 percent of the respondents agreed that the organization structure of HQSC LOGENG Sub-Branch for engineering management of the F/RF-111C Weapon System should provide a better focus at the weapon system level. The respondents varied as to the degree that the existing organization structure should be changed:

a. Over 80 percent of the respondents:

(1) highlighted the importance of being able to focus engineering management of weapon systems according to the RAAF force structure; and

(2) proposed that the majority of functions performed by AEENG1, AEENG2, AEENG3 should be grouped with some of the functions of AEENG6, WEAPENG1 and WEAPENG4 into a single section, similar to the existing F/A-18 engineering cell, and retain a functional structure for subsystems which are common to many weapon systems, or required specialized training;

b. Under 9 percent proposed that all functions associated with engineering management of the F/RF-111C Weapon System be consolidated into one section; and

c. Only 11 percent proposed that the current organization structure be retained but that improved management interfaces be implemented.

Over 72 percent of the respondents stressed that any new organization structure must promote consistency among engineering management of all RAAF weapon systems.

Measures of Organization Performance

While all respondents readily recognized that a measure of their performance was an inherent part of the annual reporting process, only 20 percent recognized the potential for conflict between performance evaluations which encourage short term performance at the expense of longer term planning.

The interview respondents were able to identify many quantitative measurements of Division and Section performance which were nearly in all cases process measures - measuring activities carried on within the organization. 27 percent of the respondents identified the number of aircraft serviceable at any one time as a results measure which related to achieving the customer's objectives. However, no respondent was able to identify a results measure which would gauge the effectiveness of engineering management as an element of the logistics infrastructure for the F/RF-111C Weapon System. When questioned about the lack of an effective results measure, 66 percent of the

respondents commented that the introduction of Total Quality Management (TQM) concepts within the HQSC Logistics Branch during the last year provided an avenue to focus HQSC LOGENG Sub-Branch efforts on customer objectives. These respondents anticipated that effective results measures and process measures would be able to be identified.

Modification Management

All SYSENGs and Assistant System Engineers (31 percent of the respondents) had issued modification orders within the last year. Although these respondents were cognizant of the relevant orders and instructions applying to modification management, different approval processes for modification orders were used among the Sections. In one Section, SYSENGs were responsible for both the development and approval of modification orders to the F/RF-111C subsystems that they were responsible for. In all other Sections, SYSENGs were responsible for the development of the modification order but the modification order was reviewed and approved by either the Sub-Section Head or both the Sub-Section Head and the Section Head. While the Section Head and Sub-Section Head were aware of the general contents of the modification, they provided a relatively independent review and approval process for each modification.

Almost 86 percent of the respondents recognized the importance of such a process which included an independent analysis of the engineering content and the impact of each modification on the airworthiness of the F/RF-111C Weapon System. Of these respondents, 47 percent believed that the prototype installation of each modification provided a satisfactory check on the engineering content and airworthiness of the F/RF-111C Weapon System.

Modification orders are issued as amendments to RAAF AAPs. The procedure used by Sections to issue modifications of an urgent nature varied between interpretation of two different instructions. The first procedure centered on using an STI as the vehicle for issue of urgent modification orders. The second procedure used an Interim Amendment (INAM) to the applicable RAAF AAP as the vehicle for issuing the modification order. Four of the eleven sections responsible for engineering management of the F/RF-111C Weapon System used the procedure involving the issue of an INAM.

In the absence of an alternative format for modification orders, respondents agreed that the following aspects would improve modification orders:

a. the SYSENG responsible for the modification should be included in the 'Additional Information' part of the modification order; and

b. a signature block should be included in the modification order. This would convey a higher level of assurance that the effect of the modification on the airworthiness and operational capability of the F/RF-111C Weapon System had been properly addressed.

Respondent's opinions varied as to what level the modification order should be signed. They provided the following comments:

a. the modification order should not be signed by the SYSENG or Assistant Systems Engineer; and

b. the modification order could be signed by either the Sub-Section Head or Section Head.

Over 91 percent of the respondents agreed that in an alternative organization structure where engineering management of the F/RF-111C Weapon System is the responsibility of one Section (similar to the existing organization structure for engineering management of the F/A-18 weapon system), all modification orders should be authorized by the equivalent of the existing Section Head.

Configuration Management

Almost 83 percent of the respondents stated that configuration management of the F/RF-111C Weapon System was performed on a basis of exception management. Respondents recalled that during 1987 and 1988, significant resources (primarily manpower) were dedicated to aligning the

configuration record with the physical configuration of the F/RF-111C Weapon System in preparation for the F/RF-111C Avionics Update Programme (AUP) configuration baseline.

Respondents provided the following comments:

a. configuration management of individual subsystems and equipments was maintained by the SYSENGs through amendment of the relevant RAAF AAP for modification-induced configuration changes;

b. the F/RF-111C TMP provided configuration control at the Line Replaceable Unit level.

The TMP provides the operating units and maintenance squadrons with authorization to install substitutable equipments for the equipments identified in the applicable RAAF maintenance publication or illustrated parts list. Over 78 percent of the SYSENGs and unit respondents recalled numerous instances where alternative equipments had been introduced in the RAAF inventory for which there was no related maintenance procedures or illustrated parts list issued as an RAAF AAP. This occurred primarily with components that superseded existing components and were introduced into the RAAF inventory as form, fit, function compatible under the same NATO Stock Number but required different maintenance procedures and spares support.

Only two of the eleven sections maintained a record of the configuration history of subsystems or equipments. Over 83 percent of the respondents noted that a traceable

configuration record for all equipments was essential to proper configuration management of the F/RF-111C Weapon System, but that existing resources prevented addressing configuration managements issues except on the basis as outlined above.

Technical Publication Management

SYSENGs are the sponsors for technical publications of F/RF-111C subsystems and equipments for which they have engineering management responsibility. Over 91 percent of the SYSENGs estimated that the usual cycle for an amendment to be issued to the affected units was in excess of 12 months. Other comments provided included:

a. some publication amendments have taken up to three years to be issued to units;

b. SYSENGs were resorting to the use of INAMs on an increasing basis to issue both urgent and non-urgent publication amendments;

c. HQSC LOGENG Sub-Branch management had taken several initiatives over the past three years which were steadily reducing the publication amendment cycle; and

d. a formal HQSC LOGENG Sub-Branch strategy for financial year 1989/90 was to develop and maintain an aggressive approach to eliminate technical data and publication backlogs to maintain management focus on the issue of publication amendments.

Unit respondents commented that specific actions taken by HQSC LOGENG Sub-Branch to reduce the publication amendment cycle appeared to achieve an initial success.

Customer Satisfaction

Respondents from the operating units and maintenance squadrons (29 percent of the interviewees) identified that their customers were the operational elements of the SRG. HQSC LOGENG Sub-Branch respondents varied in their responses. Respondents who had engineering management for F/RF-111C subsystems and equipments only nominated different elements of SRG but respondents who had engineering management responsibility for subsystems and equipments installed in different weapon systems nominated the various combat groups they supported.

These respondents commented that they sometimes had conflicting requirements in satisfying the tasking from several combat groups in terms of the resources they could commit in the required timeframe.

Researcher's Experience

During his employment in the HQSC LOGENG Sub-Branch, the researcher experienced many of the problems that respondents raised during the interviews. The researcher believes that:

a. the existing organization structure is limiting the effectiveness of engineering management provided for the F/RF-111C Weapon System when compared with the engineering management provided for the F/A-18 Weapon System under a different organization structure;

b. the annual reporting process does promote short term competition between officers and airmen of equal rank at the expense of a longer term cohesive team approach to engineering management of the F/RF-111C Weapon System;

c. while any measure is not necessarily better than none, performance measures could be readily applied to particular aspects of engineering management. For instance, periods of maximum allowable time could be mandated for review, development and issue of a modification order. Different periods of time would apply according to the classification of the modification. Similar measures could be applied to resolution of defect reports and publication amendments;

d. all changes to the configuration of the F/RF-111C Weapon System, including modifications and the introduction of substitute components, should be reviewed for their effect on the airworthiness and engineering integrity of the weapon system. All modifications should be subject to a review and approval process which specifically addresses the effect of a modification on the airworthiness and engineering integrity of the F/RF-111C Weapon System;

e. the use of an STI as the vehicle for the issue of an urgent modification duplicates management oversight using two separate management and recording procedures. Effectively, the modification is initially treated as an STI with its separate management and recording procedures, and then as a modification superseding an STI. When the modification order is formally issued subsequent to the issue of the STI, operating units and maintenance squadrons are required to physically confirm that the modification was incorporated as an STI which involves additional maintenance downtime of the affected subsystem and possibly aircraft. The INAM process is a more efficient and effective avenue for the issue of modification orders of an urgent nature;

f. an CMP(AF) should be issued for the F/RF-111C Weapon System. The researcher was the principal author of the CMP(AF) for the PAVE TACK/Guided Weapons System, which was issued in 1985. The processes and controls detailed in this CMP(AF) could form the basis for configuration management of the F/RF-111C Weapon System; and

g. identification of the modification sponsor in modification orders will provide operating units and maintenance squadrons with an immediate focus for any concerns related to an issued modification. Additionally, all modifications orders should be approved by the Section Head to demonstrate that the impact of the modification on

the airworthiness of the F/RF-111C Weapon System has been specifically considered by an independent review and approval process.

Section III - Research Question 1

The information gathered in the interview process and the literature review was used to address the three research questions. Research Question 1 was:

> Is the current level of engineering management of the F/RF-111C Weapon System satisfying force capability requirements?

To a marked extent, air operations depend for their success on effective engineering management of the weapon system. Peacetime philosophies require that engineering management effort needed to meet RAAF objectives be directed toward achieving the highest possible standard of support for a combat weapon system commensurate with the available resources.

Airworthiness, operational readiness, availability, reliability and maintainability of the F/RF-111C Weapon System is directly affected by effectiveness and quality of engineering management provided by the HQSC LOGENG Sub-Branch.

While force capability requirements are being satisfied, the interviews determined that a number of aspects of engineering management need to be reviewed to

improve HQSC LOGENG Sub-Branch's ability to respond to new and revised force capability requirements more efficiently and effectively. In particular, a lack of formal and independent review and approval of the effect of a modification on the airworthiness of the F/RF-111C Weapon System could adversely impact the force capability of the F/RF-111C Weapon System.

Similarly, integrity of technical data is being affected by the extended publication amendment cycle. This does affect the maintainability and thus availability of the F/RF-111C Weapon System.

The lack of coordination between Sections has previously resulted in the issue of modification orders which physically conflicted when installation was attempted. The force capability of the F/RF-111C Weapon System was affected by the waste of resources required to redevelop these modifications which also prevented progress of other engineering tasks and the additional aircraft downtime required to rework the modifications.

Section IV - Research Question 2

Research Question 2 was:

> Is engineering management of the F/RF-111C Weapon System being carried out in an effective manner?

The 'profit' that comes from the investment of resources in the F/RF-111C Weapon System is typically

measured in terms of force capability or operational effectiveness. Particular measures which supposedly quantify force capability include the average number of aircraft serviceable over some period of time, the reliability of major F/RF-111C aircraft subsystems, and the number of serviceable assets above aircraft fit. All these measures involve the 'sharp end', and do not take into account the level of effectiveness of the logistics infrastructure required to sustain the force capability of the F/RF-111C Weapon System.

Inputs to the logistics infrastructure, and in particular those functions and processes that involve engineering management, can be measured in quantifiable terms. These inputs include man-years and dollars.

There are currently no measures used by HQSC LOGENG Sub-Branch that quantify or qualify the effectiveness of engineering management of the F/RF-111C Weapon System. The process measures currently employed such as the number of publication establishment variation requests processed in a quarter, do not measure the effectiveness of engineering management of the F/RF-111C Weapon System.

The introduction of the TQM philosophy in the HQSC Logistics Branch will provide the necessary impetus for the definition of effectiveness measures. However, the disjointed approach to engineering management of the

F/RF-111C Weapon System as a system as opposed to separate subsystems is likely to hamper the introduction of uniform effectiveness measures across all sections. Implementation of uniform effectiveness measures will be more difficult under the current organization structure because of the differences in engineering management processes applied by different sections.

Operational units and maintenance squadrons have stressed the importance of working visits by SYSENGs to RAAF Amberley as a necessary component of effective engineering management that contributes to the force capability of the F/RF-111C Weapon System. Conversely, the lack of coordination between Sections has adversely affected the effectiveness of engineering management.

Section V - Research Question 3

Research Question 3 was:

> Are the existing organization structure, management responsibilities, and orders and instructions responsive to the engineering management requirements of the F/RF-111C Weapon System?

The current HQSC LOGENG Sub-Branch organizatior structure was described in Chapter II. This organization structure is having an adverse impact on the effectiveness of engineering management of the F/RF-111C Weapon System for the following reasons:

a. HQSC LOGENG Sub-Branch is not able to respond quickly and in a coordinated manner to the development of new or revised force capability requirements;

b. senior level management decision making is delayed while a consolidated Section response is developed;

c. interview respondents readily acknowledged the increased difficulty caused by the conflict between sections due to different resource and timeframe priorities; and

d. components of HQSC LOGENG Sub-Branch with responsibility for engineering management of the F/RF-111C Weapon System are not able to focus on the requirements of SRG only but have to consider other combat groups. This is exacerbated because the organization's goals do not clearly identify the relative priority of RAAF combat weapon systems.

The division of responsibility for engineering management of F/RF-111C subsystems is inappropriate. At the subsystem level, one SYSENG should be responsible for engineering management of all the equipments that form the subsystem. Engineering management of the Harpoon Anti-Ship Missile system should not be divided among two Sections. The division of engineering management responsibilities sustains a higher level of organization unresponsiveness that could be easily avoided.

The procedures detailed in RAAF orders and instructions are being complied with in practice. The lack of a standard

modification review and approval process which incorporates a system of 'checks and balances' does not promote the confidence of engineering integrity and maintenance of airworthiness, which is essential to sustainable air operations. Alternative methods of issuing urgent modification orders do not promote consistency, cause confusion at unit level and waste limited resources at command and unit level.

Section VI - Proposed HQSC LOGENG Sub-Branch Organization Structure

In attempting to determine the most appropriate organization structure for engineering management of the F/RF-111C Weapon System and other RAAF combat weapon systems, the organizational goal, size, organizational technology and environment are assumed to be unchanged.

What is the Optimal Organization Structure? The organization must be designed to fit its environment and to provide the information and coordination needed. For HQSC LOGENG Sub-Branch, the environment can be segmented into combat groups that form the RAAF combat force structure. Thus, the organization can focus on customer requirements at the combat force headquarters level and would be consistent with the organization structure of the combat groups. However, some engineering management functions - such as

maintenance engineering analysis, aircraft structural analysis, and aircraft weight and balance - are critical to the airworthiness of the weapon system and require specialized training. Also other functions such as aeronautical, avionic and explosive standards and some common subsystems (such as oxygen subsystems) with substantial commonality between different weapon systems should be the responsibility of the same section for all weapon systems. Thus, the organization would ideally minimize duplicated resources while being able to provide effective engineering management of weapon systems. The four types of organization structure discussed in Chapter II are compared in the following paragraphs.

Functional Organization Structure. The weaknesses evident in the existing functional organization structure make this type of organization structure unsuitable for further consideration.

Self-Contained Unit Organization Structure. Table 1 identifies the strengths and weaknesses of this type of organization structure. The self-contained unit organization structure strengths include client focus and satisfaction, and product goal emphasis. Its weaknesses include duplication of resources and reduced technical specialization and expertise. Thus, while providing the required focus on customer needs, this type of organization

does not sustain technical specialization in critical areas of engineering management.

Matrix Organization Structure. Matrix organization structures are complicated to manage. Duncan notes that the matrix form of an organization structure should only be used in those situations where an organization faces an unique problem in particular market area or in the technological requirements of a product. The key characteristic of the matrix organization structure is that both the heads of the functions and the matrix manager have authority over those working in the matrix unit (15:106-107). The RAAF has not utilized matrix organization structures, as other organizations within the RAAF can achieve their operational goals in their environment using simpler forms of organization structures. Thus, if HQSC LOGENG Sub-Branch was to be organized into a matrix organization structure, the initial effectiveness of individuals working within the matrix unit would be reduced by having to develop an understanding of the matrix organization structure and the necessary interpersonal skills of working for two bosses. As the length of posting to an appointment within HQSC LOGENG Sub-Branch is typically three years, these disadvantages outweigh the advantages the matrix organization structure offers.

Hybrid Organization Structure. The hybrid organization structure allows the 'product' segmentation by weapon system

while centralizing certain functions to improve the overall effectiveness of an organization, albeit at some level of reduced efficiency. Any organization structure must satisfy the operational goals in its environment effectively before consideration can be given to efficiencies of operation.

Of the four types of organization structure, the hybrid organization structure is the most appropriate organization structure for HQSC LOGENG Sub-Branch. A proposed organization structure is detailed in Figure 3; section responsibilities are detailed in Table 3. The proposed organization structure provides a focus on individual customers within the RAAF while maintaining the necessary expertise in those areas where specialized training is required. The following aspects are noted:

a. the proposed organization structure can provide effective engineering management of all RAAF weapon systems;

b. responsibility for engineering management of avionic subsystems and other aircraft equipments that are common to two or more aircraft types will be allocated to the aircraft engineering section that has the most equipment assets;

c. a single engineering standards section is created from the existing separate standards cells in each Section to provide the same engineering standard to all RAAF weapon systems;

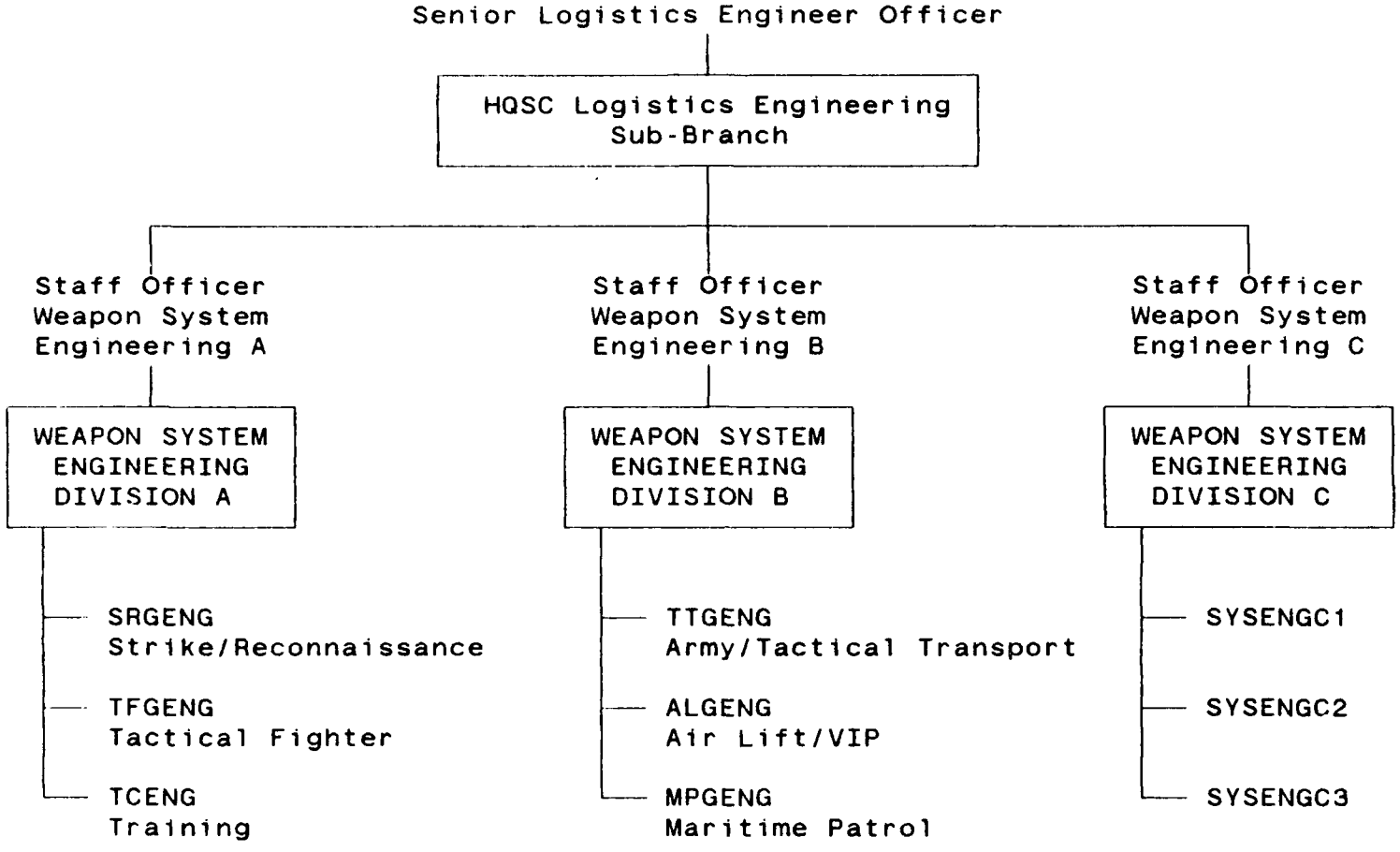

Figure 3: Proposed HQSC LOGENG Sub-Branch Organization

Table 3: Proposed HQSC LOGENG Sub-Branch Section Responsibilities

Section	Responsibility
SRGENG	F/RF-111C aircraft systems and unique ATE/GSE.
TFGENG	F/A-18 and MB-326H aircraft systems and unique ATE/GSE.
TCENG	CT-4 and PC-9 aircraft systems and unique ATE/GSE.
TTGENG	Bell 206B-1, Blackhawk, Caribou, Chinook, Iroquois and Nomad aircraft systems and unique ATE/GSE.
ALGENG	B707, C-130E, C-130H, Falcon 900 and HS-748 aircraft systems and unique ATE/GSE.
MPGENG	P-3C aircraft systems and unique ATE/GSE.
SYSENGC1	Common aircraft systems, common ATE/GSE, airborne guided systems, common emergency egress systems, engines and engine systems, safety and survival equipment.
SYSENGC2	Technical maintenance plans, maintenance engineering analysis, aircraft structural and fatigue analysis and aircraft weight and balance, technical substitution, fuels, lubricants and chemicals, non-destructive inspections and early failure detection, materials and processes.
SYSENGC3	Engineering standards.

d. the lack of coordination and interaction between existing functional areas of HQSC LOGENG Sub-Branch will be eliminated and engineering personnel working within the same

engineering section will be able to focus more clearly on combat force capability requirements; and

e. decision making is devolved to a lower level in the organization structure, where information is more readily available. This will make the organization more responsive to changes in the environment.

The proposed SRGENG Section includes the following elements of the existing organization structure:

a. AIRENG1 - F/RF-111C aircraft systems;

b. AEENG1 - F/RF-111C instrument systems and F-111C flight simulator;

c. AEENG2 - F/RF-111C electrical systems;

d. AEENG3 - F/RF-111C radar systems and airborne telecommunications systems;

e. AEENG6 - F/RF-111C unique ATE and GSE;

f. WEAPENG1 - F/RF-111C ordnance systems; and

g. WEAPENG4 - F/RF-111C emergency egress system.

The SYSENGC1 Section assumes responsibility for those aircraft subsystems which are common to two or more weapon systems and whose engineering management would be judged to be more efficient as separate to the weapon system major user.

The SYSENGC2 Section assumes the responsibilities of the existing AIRENG3 and AIRENG4 sections. The SYSENGC3 Section consolidates the individual section standard cells

to ensure the application and maintenance of the required levels of engineering integrity across all weapon systems.

Effect of Restructuring of Air Force Office

As a result of the Structural Review of Higher Defence Staff Arrangements, AFO was restructured with effect from 28 February 1990. The major changes to the present structure were [inter alia]:

a. Development, Engineering and Supply Divisions within AFO were eliminated;

b. HQSC was concurrently divided into two newly formed commands, Headquarters Logistics Command (HQLC) and Headquarters Training Command (HQTC); and

c. Various functions of the eliminated Divisions were transferred to the Deputy Chief of Air Staff and Materiel Divisions at AFO, and HQLC (11:1).

The RAAF now comprises three functionally oriented Divisions at AFO and three functional commands - AHA, HQLC and HQTC. This restructuring and the subsequent creation of HQLC will enable HQLC to provide improved concentration on the requirements of the logistics infrastructure necessary to support the force capability of all RAAF combat weapon systems.

Summary

An analysis of the data from the interviews and the literature review collected as part of this research

identified that the effectiveness of engineering management of the F/RF-111C Weapon System is being affected by the following:

a. the current HQSC LOGENG Sub-Branch organization structure limits the effectiveness of engineering management of the F/RF-111C Weapon System;

b. too much conflict arises between sections responsible for engineering management of the F/RF-111C Weapon System;

c. organization goals are not identifiable with customer requirements and the lack of measures of effectiveness inhibit gauging the success of the current engineering management and any proposed change;

d. modification management is being degraded by the lack of application of consistent standards and processes across all sections;

e. a CMP-AF does not exist for the F/RF-111C Weapon System; configuration control is managed on an exception basis and is not consistent across sections; and

f. the integrity of technical data, which forms the basis for valid engineering, maintenance and supply support for the F/RF-111C Weapon System is being degraded by the lengthy publication amendment cycle.

An alternative organization structure was proposed for engineering management of all RAAF combat weapon systems.

This hybrid organization structure provides emphasis on engineering management of weapon systems while centralizing certain functions.

Lastly, the effect of restructuring AFO and the concurrent creation of HQLC was noted. HQLC should be able to provide increased emphasis on developing an effective logistics infrastructure to sustain RAAF air operations.

V. Conclusions and Recommendations

Overview

The purpose of this research was to make an assessment of the effectiveness of engineering management of the RAAF F/RF-111C Weapon System by HQSC LOGENG Sub-Branch.

The traditional approach to engineering management of RAAF combat weapon systems has involved assigning responsibility for subsystems to Sections within the HQSC LOGENG Sub-Branch. Management of combat weapon systems at the system level has not been emphasized. The organization structure of the HQSC LOGENG Sub-Branch has promoted the management of the subsystem at the expense of the system.

This research began with the documentation of the existing procedures for engineering management of the F/RF-111C Weapon System. This was achieved by reviewing: (1) the division of engineering responsibilities; (2) existing technical instructions and publications; (3) organization structure concepts and measures of organization effectiveness; (4) modification management and configuration management. Formal interviews with RAAF officers and technical airmen identified the current effectiveness of engineering management of the F/RF-111C Weapon System.

Section I - Conclusions

Four conclusions can be drawn from this research: (1) the effectiveness of engineering management of the F/RF-111C Weapon System is deficient in a number of areas and can be improved; (2) the review and approval process for modification orders should be standardized; (3) configuration control of the F/RF-111C Weapon System is inadequate; and (4) the integrity of technical data can be questioned because of the lengthy publication amendment cycle. These conclusions are expanded in the following paragraphs.

Effectiveness of Engineering Management

The current organization structure imposes limits on the effectiveness of engineering management of the F/RF-111C Weapon System. A hybrid organization structure would allow emphasis to be placed at the weapon system level while centralizing those functions which provide increased management efficiency. The proposed HQSC LOGENG Sub-Branch organization structure aligns resource allocation with the force structure of the RAAF, allowing resources to be committed according to the relative priority of different weapon systems and allowing personnel to more closely align with a visible end product and support the policy of career streaming introduced in 1988. The proposed organization

structure would also devolve the decision making process to a lower level in the organization.

Modification Management

Modifications to the F/RF-111C Weapon System are currently not managed as an integrated system. Several instances were identified where a lack of coordination between sections in HQSC LOGENG Sub-Branch resulted in modifications being issued which either functionally or physically conflicted. Additionally, current management procedures for review and approval of modifications does not promote constancy of airworthiness or engineering integrity. The proposed SRGENG Section would ensure that modification management of F/RF-111C systems is consistent. Existing modification management procedures should be amended to include a review and approval process which ensures and independent analysis of the impact of each modification on the airworthiness of the F/RF-111C Weapon System.

Configuration Management

The current organization structure nurtures different management philosophies for all aspects of F/RF-111C Weapon System engineering management. Configuration management of the F/RF-111C Weapon System is deficient because an CMP(AF) has not been issued which provides separate Sections to allocate different levels of commitment to configuration control and recording. The F/RF-111C AUP provides a

suitable point in the operational life of the F/RF-111C Weapon System at which to introduce an CMP(AF) which will detail configuration control requirements for the F/RF-111C post-AUP.

Technical Publication Management

The integrity of technical data is of paramount importance to the airworthiness and operational capability of the F/RF-111C Weapon System. The existing publication amendment cycle was recognized at the Command and unit level as inhibiting the logistics infrastructure in providing timely support for the F/RF-111C Weapon System.

Section II - Recommendations

This research recommends that:

a. the organization structure of the HQSC LOGENG Sub-Branch be amended to provide increased emphasis on engineering management at the weapon system level;

b. the review and approval process for modification orders should be standardized and include an independent review process of the technical content and the effect of each modification on the airworthiness of the weapon system;

c. an CMP(AF) should be issued to detail the required management processes for configuration control of the F/RF-111C Weapon System; and

d. HQSC LOGENG Sub-Branch should continue to reduce the publication amendment cycle time to promote the integrity of technical data of the F/RF-111C Weapon System.

Section III - Recommendations for Further Research

Further research is recommended to develop performance measures, and in particular results measures, that could be applied to determine the effectiveness of the logistics infrastructure in sustaining combat weapon systems.

Appendix A: Glossary of Terms, Abbreviations and Acronyms

Glossary of Terms

Configuration Management. Configuration management is the name given to that area of management concerned with the system and procedures for controlling performance requirements and physical configuration of designated items. (32:24-1)

Configuration Management Plan (Air Force). The Configuration Management Plan (Air Force) (CMP(AF)) is a plan, prepared by DEFAIR ENG staff at the start of a project, which outlines the extent of configuration management and control required over technical equipment during its life cycle, states who is responsible for various facets of management and control and defines any approved contractual arrangements affecting implementation of the CMP. (29:1)

Division Heads. Division Heads are responsible to SLENGO for planning, organizing, directing, coordinating and controlling to ensure that engineering functions are accomplished efficiently by the respective sections, ensuring always that adequate engineering standards are maintained. They are also responsible for a statement of airworthiness requirements including the frequency, depth and planning of maintenance requirements to meet these airworthiness standards giving adequate consideration to cost effectiveness without degradation of mission accomplishment. (38:3)

Effectiveness Factors. Effectiveness factors are availability, dependability and capability and the attendant subdivisions including reliability, maintainability, safety, survivability and vulnerability. (6:329)

Engineering Management. The management of the engineering and technical effort required to transform a military requirement into an operational system. It includes the system engineering required to define the system performance parameters and preferred system configuration to satisfy the requirement, the planning and control of the technical program tasks, integration of the engineering specialities, and the management of a totally integrated effort of design engineering, speciality engineering, test engineering, logistics engineering, and production engineering to meet cost, technical performance and schedule objectives. (13:2)

Engineering Functions.

a. Management of engineering and airworthiness.

b. Design approval of technical equipment as detailed in DI(AF) TECH 4-8.

c. Management of the configuration of technical equipment throughout its life cycle, as detailed in DI(AF) TECH 4-8.

d. Compilation, issue and review of Special Technical Instructions, as detailed in DI(AF) TECH 5-8.

e. Investigation and rectification of defects, as detailed in DI(AF) TECH 4-2.

f. Authorization of modifications, introduction of modifications and supervision of modification incorporation, as detailed in DI(AF) TECH 19-1.

g. Control of the Failure Reporting System (FRS), as detailed in DI(AF) TECH 4-5.

h. Management of structural fatigue matters, fatigue life monitoring, and monitoring of all structural fatigue matters arising from defect reporting or from investigations into aircraft accidents or incidents as detailed in DI(AF) TECH 12-2.

i. Management of Non-Destructive Inspection (NDI) within the RAAF as detailed in DI(AF) TECH 17-9.

j. Within Australia, supervision of all engineering activities carried out for the RAAF by civilian contractors and Government establishments as detailed in DI(AF) TECH 3-9.

k. Management of technical data, including the preparation, approval, issue, amendment and custody as applicable of engineering standards, specifications, engineering and technical equipment data, master copies of drawings and design and development records, as detailed in DIs(AF) TECH 5-1 and TECH 11-1.

l. Review, maintenance, control and issue of servicing schedules and Technical Maintenance Plans (TMPs), as detailed in DIs(AF) TECH 17-1 and TECH 17-8. (27:1-2)

Life of Type. Life of Type is the period of operational service of a weapon system. (24:2-4)

Modification. A modification is an approved design change to RAAF technical equipment which:

a. improves the safety, operational use, reliability, maintainability or other specific design requirement of the equipment;

b. involves significant changes in production or changes which have to be made to equipment already produced or supplied;

c. affects the cost or delivery programme of the equipment of its service spares; or

d. affects interchangeability of the equipment or of its service spares. (37:1)

Section Head. The broad range of associated technical equipment delegated to a Division Head is divided amongst Section Heads for more detailed management. The management of this equipment involves the planning, direction, coordination and control of activities and the provision of advice and assistance in the development and/or statement of technical standards. (38:6)

Sub-Section Head. The technical equipment delegated to a Section Head for management is further sub-divided amongst Sub-Section Heads to allow more detailed supervision and management of the engineering and administrative aspects. (38:7)

Systems Engineer. The SYSENG is a RAAF Engineer Officer with responsibility for the engineering management of a range of technical equipment and any specific engineering actions or project activities pertaining to that equipment. Evaluation and development of modifications is a typical example of a SYSENG's responsibility. (38:2)

Type Record. A Type Record is a document giving a description of the item, design assumptions and strength calculations, including reference to all tests and indexing information. The design certificate is attached to, and forms part of a Type Record and in some cases, with relevant supporting data, is acceptable as a Type Record. (29:1)

Abbreviations and Acronyms

3AD	No 3 Aircraft Depot RAAF Amberley
482SQN	No 482 Maintenance Squadron RAAF Amberley
AAP	Australian Air Publication
AFCS	Automatic Flight Control System
AFO	Air Force Office
AFTD	Air Force Technical Directive
AFTI	Air Force Temporary Instruction
AHA	Air Headquarters Australia
ALC	[USAF] Air Logistics Center
ATE	Automatic Test Equipment
AUP	[F/RF-111C] Avionics Update Programme
AVES	[482SQN] Avionics Engineering Section
CMP(AF)	Configuration Management Plan (Air Force)
DEFAIR ENG	Department of Defence (Air Force Office) Engineering Division
DI(AF)	Defence Instruction (Air Force)
DTIC	Defense Technical Information Center
GSE	Ground Support Equipment
HQLC	Headquarters Logistics Command (previously HQSC LOGBR)
HQSC	Headquarters Support Command
HQTC	Headquarters Training Command
INAM	Interim Amendment
LBRI	Logistics Branch Routine Instruction
LBRI(ENG)	LBRI - Engineering
LOGENG	Logistics Engineering
RAAF	Royal Australian Air Force
SRG	Strike and Reconnaissance Group
SYSENG	Systems Engineer
TECH	Technical
TLO	Technical Liaison Office
TMP	Technical Maintenance Plan
TQM	Total Quality Management

Appendix B: RAAF Modification Management Policy

Policy guidance for RAAF management of modification programs is provided by the following documents:

a. DI(AF) TECH 2-2 Technical Responsibilities-Headquarters Support Command identifies that HQSC is responsible for the management of all modification programs to RAAF technical equipment as detailed in DI(AF) TECH 19-1 (27:1).

b. DI(AF) TECH 19-1 Modification of RAAF Technical Equipment - General provides the singularly highest level of policy direction for modification of all RAAF technical equipment, including weapon systems (31:1).

c. DI(AF) AAP 7001.025 Configuration Management Technical Procedures for Design Development Production and Modification of RAAF Technical Equipment provides comprehensive direction on the processes associated with the origin, approval, development and incorporation of modifications in a weapon system (32:1).

d. DI(AF) AAP 7001.040-1 Procedures for Software Configuration Management provides direction on the processes associated with the configuration management of software (33:1).

e. HQSC LBRI 103-1 Modification Management-Logistics Branch outlines the modification management policy within the HQSC Logistics Branch (36:1).

e. Additional HQSC Logistics Branch Routine Instructions (LBRIs) supplement the policy guidelines of DI(AF) AAP 7001.025, include specific executive and operative level instructions, and provide: detailed information on the procedures of the modification process from time of inception to fleet incorporation; responsibilities of various divisions within the HQSC Logistics Branch; coordination requirements; modification authorization procedures; procedures for drafting and issuing modification orders; and modification recording and reporting procedures (39; 40; 41; 42; 43; 44; 45).

Appendix C: RAAF Classes of Modification

Modifications to RAAF technical equipment fall into one of six classes depending on the circumstances and urgency of their embodiment. These classifications are:

a. Class 1. Class 1 modifications are compulsory, and are essential for safety. Their absence may involve grounding of aircraft or severe limitations on the use of aircraft and they require immediate retrospective embodiment.

b. Class 2. Class 2 modifications are compulsory, and are those that justify high priority retrospective incorporation. Their absence may result in operational limitations of the aircraft, or seriously impair technical efficiency.

c. Class 3. Class 3 modifications are of less importance than Class 2 modifications, but are such that the gain in operational efficiency, reliability or economy of operation, servicing or maintenance is judged to outweigh the cost and effort of retrospective embodiment.

d. Class 4. Class 4 modifications are those which introduce improved spares which are interchangeable with the superseded type, but are not subject to retrospective incorporation.

e. Special Order Only. Special Order Only (SOO) modifications are those necessary to satisfy a limited operational need.

f. Record Purposes Only. Record Purposes Only (RPO) modifications are those used to call drawing changes into Master Record Indexes (or equivalent data) or to record modification information (31:1-2).

Appendix D: Interview Respondents

Pre-Test Interview Respondents

Group Captain Bennett, SOAEENG, HQSC
Squadron Leader Bugden, AEENG1A, HQSC
Squadron Leader Sykes, AVO NAVAIR
Squadron Leader Walter, AVO SM-ALC
Flight Sergeant Box, AEENG1A5, HQSC

Interview Respondents

Group Captain Middleton, 3AD, RAAF Amberley
Group Captain Webber, 482SQN, RAAF Amberley

Wing Commander Brown, 482SQN, RAAF Amberley
Wing Commander Crowther, SOENGS, HQSC
Wing Commander (retired) Hesketh, 482SQN, RAAF Amberley
Wing Commander (retired) Mascini, 3AD, RAAF Amberley
Wing Commander Moreland, AEENG3, HQSC
Wing Commander Smith, AEENG2, HQSC
Wing Commander Thies, AEENG2-AF, AFO

Squadron Leader Aeschliman, 3AD, RAAF Amberley
Squadron Leader Devantier, AEENG3A, HQSC
Squadron Leader McCormack, AEENG1B, HQSC
Squadron Leader McDougall, AIRENG1D, HQSC
Squadron Leader Percival, SOAEENG, RAAFWASH

Flight Lieutenant Bastock, AEENG1A2, HQSC
Flight Lieutenant Bidgood, 482SQN, RAAF Amberley
Flight Lieutenant Birrell, AEENG1B3, HQSC
Flight Lieutenant Carrera, AEENG1B4, HQSC
Flight Lieutenant Chang, SG7A1, HQSC
Flight Lieutenant Hogan, 3AD, RAAF Amberley
Flight Lieutenant McPhail, 3AD, RAAF Amberley
Flight Lieutenant Passfield, 3AD, RAAF Amberley
Flight Lieutenant Patacca, AEENG3B3, HQSC
Flight Lieutenant Perticato, AEENG1A4, HQSC
Flight Lieutenant Webster, AEENG2A3, HQSC
Flight Lieutenant Wharley, AEENG1B5, HQSC

Warrant Officer Sears, AEENG1B3A, HQSC
Warrant Officer Lee, AEENG1A1A, HQSC

Flight Sergeant Cass, AEENG1B5A, HQSC

Sergeant Worthington, AEENG1A4A, HQSC

Appendix E: Pre-Test Interview Questionnaire

Introduction

Squadron Leader Robert Black was posted to the United States Air Force Institute of Technology in May 1989 to undertake a Masters of Science Degree in Logistics Management. As part of this degree, Squadron Leader Black is conducting research to assess the effectiveness of engineering management of the RAAF F/RF-111C Weapon System.

The research is limited to following specific aspects of engineering management of the F/RF-111C Weapon System:

a. organization, functions and responsibilities of the HQSC Logistics Engineering Sub-Branch;

b. modification management;

c. configuration management; and

d. technical publication management.

Purpose of Interview Questionnaire

The purpose of this interview questionnaire is to seek the professional opinions of selected RAAF Engineer Officers and technical airmen on the effectiveness of engineering management of the F/RF-111C Weapon System.

Aim

This interview has several aims:

a. verify that the published instructions and orders are being complied with in practice;

b. confirm the perceived deficiencies of current engineering management processes that SQNLDR Black believes to be true;

c. highlight other deficiencies of current engineering management processes; and

d. solicit concepts of alternative engineering management processes that would improve the effectiveness of engineering management of the F/RF-111C Weapon System.

Anonymity

All personnel who agree to be interview respondents will be listed as respondents. However, respondents will NOT have comments directly attributed to them.

Recording of Interview

Under the condition of anonymity, do I have your permission to record our interview so as I do not have to take notes while talking?

YES _____ NO _____

Previous Experience and Training

Would you please provide the following details:

a. Prior to your current appointment, what previous HQSC LOGENG Sub-Branch experience do you have?

Comments:

b. Do you have any F/RF-111C Weapon System unit level experience?

Comments:

c. Have you completed any courses annotated as either essential or desirable on your duty statement?

Comments:

1. Organization Structure

1.1 Have you undertaken any formal courses which have included discussions of organizations, organization design and structures?

YES _____ NO _____

1.2 Typical symptoms of an organization structure that hinders an organization in achieving its objectives include:

a. the organization does not respond quickly or innovatively to changes within HQSC and outside of HQSC;

b. managerial decision making may be delayed or lack in quality;

c. too much conflict within the organization will be evident; and

d. the organization will not achieve performance goals.

Have you experienced any of these symptoms?

YES _____ NO _____

Comments:

1.3 Do you have any ideas of alternate organization structures that may permit more effective engineering management of the F/RF-111C Weapon System (such as the F/A-18 Weapon System)?

YES _____ NO _____

1.4 Do you have any other comments regarding the current organization structure?

Comments:

2. Measures of Organization Performance

2.1 How is your performance measured?

Comments:

2.2 If you have subordinates, how do you measure their performance?

Comments:

2.3 Does your Section have any quantitative measurements of its performance?

YES _____ NO _____

Comments:

2.4 Does your Section have any qualitative measurements of its performance?

YES _____ NO _____

2.5 Do you have any other comments regarding measures of organization performance?

Comments:

3. Modification Management

3.1 Have you issued modification orders?

YES _____ NO _____

3.2 What is the approval process for modification orders that you are responsible for?

Comments:

3.3 At what level is the engineering content and airworthiness impact of the modification assessed?

Comments:

3.4 What procedure to you use to issue modification orders of an urgent nature?

Comments:

3.5 Do you have any suggestions to improve the modification order format?

Comments:

3.6 Do you think that the modification order should have a signature block? At what level should a modification order be signed?

Comments:

3.7 Do you have any other comments regarding modification management?

Comments:

4. Configuration Management

4.1 How do you manage the configuration of the systems and equipments that you are responsible for?

Comments:

4.2 Do you maintain a master register or log of the current configuration and the configuration history of each system and/or equipment?

YES _____ NO _____

4.3 Do you have any other comments regarding configuration management?

Comments:

5. Technical Publication Management

5.1 Are you the publication sponsor for any technical publications?

YES _____ NO _____

(If NO, please answer go to Section 5.2)

5.1 Amendment Process - Publication Sponsor

5.1 Can you provide an estimate of how long it usually takes for an amendment to a technical publication to be issued to the affected unit(s)?

__ 0 - 3 months
__ 4 - 6 months
__ 7 - 9 months
__ 10 - 12 months
__ > 12 months

5.2 Are you satisfied at the usual length of time taken to process an amendment?

YES _____ NO _____

5.3 Have you received criticism (positive or negative) on the length of time it takes to process an unit sponsored amendment to be formally issued?

YES _____ NO _____

5.4 Do you carry out any of the following publication amendment functions:

a. initiate amendments?

YES _____ NO _____

b. review amendments?

YES _____ NO _____

c. approve amendments?

YES _____ NO _____

5.5 Do you have nay other comments regarding technical publication management?

Comments:

5.2 Amendment Process - Unit Level

5.6 Can you provide an estimate of how long it usually takes for an amendment to a technical publication to be issued by the publication sponsor?

__ 0 - 3 months
__ 4 - 6 months
__ 7 - 9 months
__ 10 - 12 months
__ > 12 months

5.7 Are you satisfied at the usual length of time taken to process an amendment?

YES _____ NO _____

5.8 Do you have any other comments regarding technical publication management?

Comments:

6. Customer Satisfaction

6.1 Who is/are your customer(s)?

Comments:

6.2 Are you satisfied with the quantitative and qualitative levels of service that you provide to your customers?

Comments:

Conclusion

I sincerely appreciate the time you made available to respond to this interview questionnaire.

I have been posted to the Directorate of Integrated Logistics Requirements (ILR1A-AF) and I will be able to provide you with a copy of the results of my research after December 1990.

Appendix F: Interview Questionnaire

Introduction

Squadron Leader Robert Black was posted to the United States Air Force Institute of Technology in May 1989 to undertake a Masters of Science Degree in Logistics Management. As part of this degree, Squadron Leader Black is conducting research to assess the effectiveness of engineering management of the RAAF F/RF-111C Weapon System.

The research is limited to following specific aspects of engineering management of the F/RF-111C Weapon System:

a. organization, functions and responsibilities of the HQSC Logistics Engineering Sub-Branch;

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Purpose of Interview Questionnaire

The purpose of this interview questionnaire is to seek the professional opinions of selected RAAF Engineer Officers and technical airmen on the effectiveness of engineering management of the F/RF-111C Weapon System.

Aim

This interview has several aims:

a. verify that the published instructions and orders are being complied with in practice;

b. confirm the perceived deficiencies of current engineering management processes that SQNLDR Black believes to be true;

c. highlight other deficiencies of current engineering management processes; and

d. solicit concepts of alternative engineering management processes that would improve the effectiveness of engineering management of the F/RF-111C Weapon System.

Anonymity

All personnel who agree to be interview respondents will be listed as respondents. However, respondents will NOT have comments directly attributed to them.

Recording of Interview

Under the condition of anonymity, do I have your permission to record our interview so as I do not have to take notes while talking?

YES _____ NO _____

Previous Experience and Training

Would you please provide the following details:

a. Prior to your current appointment, what previous HQSC LOGENG Sub-Branch experience do you have?

Comments:

b. Do you have any F/RF-111C Weapon System unit level experience?

Comments:

c. Have you completed any courses annotated as either essential or desirable on your duty statement?

Comments:

d. How well do you believe the introductory HQSC Logistics Branch and Logistics Engineering Sub-Branch courses prepared you for your current appointment?

Comments:

1. Organization Structure

1.1 Have you undertaken any formal courses which have included discussions of organizations, organization design and structures?

YES _____ NO _____

1.2 Typical symptoms of an organization structure that hinders an organization in achieving its objectives include:

a. the organization does not respond quickly or innovatively to changes within HQSC and outside of HQSC;

b. managerial decision making may be delayed or lack in quality;

c. too much conflict within the organization will be evident; and

d. the organization will not achieve performance goals.

Have you experienced any of these symptoms?

YES _____ NO _____

Comments:

1.3 Are there any advantages that the current organization structure provides to the engineering management of the F/RF-111C Weapon System?

YES _____ NO _____

1.4 Do you have any ideas of alternate organization structures that may permit more effective engineering management of the F/RF-111C Weapon System (such as the F/A-18 Weapon System)?

YES _____ NO _____

1.5 Do you have any other comments regarding the current organization structure?

Comments:

2. Measures of Organization Performance

2.1 How is your performance measured?

Comments:

2.2 If you have subordinates, how do you measure their performance?

Comments:

2.3 Does your Section have any quantitative measurements of its performance?

YES _____ NO _____

Comments:

2.4 Does your Section have any qualitative measurements of its performance?

YES _____ NO _____

2.5 Do you have any other comments regarding measures of organization performance?

Comments:

3. Modification Management

3.1 Have you issued modification orders?

YES _____ NO _____

3.2 What is the approval process for modification orders that you are responsible for?

Comments:

3.3 At what level is the engineering content and airworthiness impact of the modification assessed?

Comments:

3.4 What procedure to you use to issue modification orders of an urgent nature?

Comments:

3.5 Do you have any suggestions to improve the modification order format?

Comments:

3.6 Do you think that the modification order should have a signature block? At what level should a modification order be signed?

Comments:

3.7 Do you have any other comments regarding modification management?

Comments:

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4.1 How do you manage the configuration of the systems and equipments that you are responsible for?

Comments:

4.2 Do you have any other comments regarding configuration management?

Comments:

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5.1 Are you the publication sponsor for any technical publications?

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(If NO, please answer go to Section 5.2)

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5.1 Can you provide an estimate of how long it usually takes for an amendment to a technical publication to be issued to the affected unit(s)?

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5.2 Are you satisfied at the usual length of time taken to process an amendment?

YES _____ NO _____

5.3 Have you received criticism (positive or negative) on the length of time it takes to process an unit sponsored amendment to be formally issued?

YES _____ NO _____

5.4 Do you carry out any of the following publication amendment functions:

a. initiate amendments?

YES _____ NO _____

b. review amendments?

YES _____ NO _____

c. approve amendments?

YES _____ NO _____

5.5 Do you have nay other comments regarding technical publication management?

Comments:

5.2 Amendment Process - Unit Level

5.6 Can you provide an estimate of how long it usually takes for an amendment to a technical publication to be issued by the publication sponsor?

__ 0 - 3 months
__ 4 - 6 months
__ 7 - 9 months
__ 10 - 12 months
__ > 12 months

5.7 Are you satisfied at the usual length of time taken to process an amendment?

YES _____ NO _____

5.8 Do you have any other comments regarding technical publication management?

Comments:

6. Customer Satisfaction

6.1 Who is/are your customer(s)?

Comments:

6.2 Are you satisfied with the quantitative and qualitative levels of service that you provide to your customers?

Comments:

7. Other Aspects of Engineering Management

7.1 Do you have any other comments regarding engineering management of the F/RF-111C Weapon System?

Comments:

Conclusion

I sincerely appreciate the time you made available to respond to this interview questionnaire.

I have been posted to the Directorate of Integrated Logistics Requirements (ILR1A-AF) and I will be able to provide you with a copy of the results of my research after December 1990.

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Vita

Squadron Leader Robert R. Black [redacted] completed his secondary school education at Ku-ring-gai High School. In January 1978 he joined the Royal Australian Air Force as an Engineer Cadet and subsequently completed a Degree of Bachelor of Engineering in Electronic Engineering at the Royal Melbourne Institute of Technology in December 1981. Squadron Leader Black was commissioned as an Engineer Officer in the Instrument Category in December 1981. He served as Officer in Charge of Aircraft Equipment Maintenance Flight at No 1 Flying Training School from 1982 to 1984. Between 1984 and 1989, Squadron Leader Black served in various appointments in AEENG1 in Headquarters Support Command Logistics Engineering Sub-Branch as a Systems Engineer and Sub-Section Head. In May 1989 he entered the graduate logistics management course at the United States Air Force Institute of Technology School of Systems and Logistics to study for a Master of Science Degree in Logistics Management.

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13. ABSTRACT *(Maximum 200 words)*

The purpose of this research was to assess the effectiveness of engineering management of the Royal Australian Air Force (RAAF) F/RF-111C Weapon System by Headquarters Support Command (HQSC) Logistics Engineering (LOGENG) Sub-Branch. The research was limited to considering the organization, functions and responsibilities of HQSC LOGENG Sub-Branch, modification management, configuration management and technical publication management.

The division of engineering responsibilities within the RAAF and existing engineering management policy and procedures as detailed in various technical instructions and publications were documented. The strengths and weaknesses of various organization structures were then described. Measures of organization effectiveness, modification management and configuration management were addressed. Formal interviews were conducted to determine the existing level of effectiveness of engineering management.

The research concluded that the effectiveness of engineering management of the F/RF-111C Weapon System can be improved. The research recommends that HQSC LOGENG Sub-Branch be reorganized into a hybrid organization structure, a standard review and approval process for modifications be implemented, a configuration management plan be issued for the F/RF-111C Weapon System and the publication amendment cycle be improved to increase the integrity of technical data.

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